

1927 LAKESIDE PARKWAY SUITE 614 TUCKER, GEORGIA 30084 404-938-7710

ATLANTA, CA.

C-586-1-9-91

January 16, 1989

Mr. Narindar Kumar Site Investigation and Support Branch **Waste Management Division Environmental Protection Agency** 345 Courtland Street, N. E. Atlanta, Georgia 30365

Date:

Site Disposition:

EPA Project Manager:

s ERRP

Subject:

Preliminary Reassessment

Sirco Systems

Birmingham, Jefferson County, Alabama

TDD No. F4-8804-53

Dear Mr. Kumar:

FIT 4 conducted a preliminary reassessment of the Sirco Systems facility in Birmingham, Jefferson County, Alabama. The reassessment included a comprehensive review of EPA and state file material, completion of a target survey, and a drive-by reconnaissance of the site and surrounding area on April 25, 1988.

The Sirco Systems facility began operation in 1950 (Ref. 1). The company was owned by the Reynolds Metals Company until 1979 when the Sirco Systems Company was purchased by the Jemison Investment Company. The facility is located on leased land which is owned by Reynolds Aluminum, Liberty National Insurance, Norfolk Southern Railway, and Walker C. Madison (Ref. 2).

The Sirco Systems facility produces components for steel drums (Ref. 3). Waste is produced in the form of solvents which are generated in a roll coat painting process. A wax material is used to coat the metal for drums (Ref. 4). The raw material's trade name is Ferrocote 120 and is composed of polyethylene, fatty acid soaps, petroleum sulfonate, and water (Ref. 5). This substance is mixed with water and recycled until the mixture is approximately 75 percent water and will no longer stick to metal. This waste product is then drained off into 55-gallon drums for disposal (Ref. 4).

The facility generated waste from approximately 1950 through 1981 and produced approximately fifteen 55-gallon drums of waste annually (Refs. 1, 2). Approximately eighty to ninety 55-gallon drums of waste had accumulated at the facility in 1981 (Ref. 4). In the same year the accumulated waste was purchased by All-Worth, Inc. of Birmingham for recycling (Ref. 6). All-Worth later refused to accept any additional waste until Sirco Systems obtained an EPA Generator I.D. Number (Ref. 2). Beginning in 1982, waste paper and scrap steel were the only wastes generated at the facility until an EPA I.D. Number was issued to the facility 1984 (Refs. 6, 7). Interviews and an inspection of the property revealed no evidence or knowledge of any past or present dumping activities at the facility (Refs. 3, 6, 8).

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Sirco Systems is located in the Birmingham Valley physiographic section of the Valley and Ridge physiographic province (Ref. 9). The area is characterized by northeast-southwest trending valleys and ridges which exhibit extensive faulting and folding (Ref. 9, p. 1, 3). As a result of these structural features vast differences in geologic and hydrogeologic environments occur over distances of only a few miles (Ref. 9, p. 1). Groundwater occurs in solution cavity channels and fracture zones within these tectonically altered rock units (Ref. 10). Recharge to groundwater is by percolation of precipitation. Net annual rainfall for the area is 11 inches (Ref. 11).

Geologic units that occur within a 4-mile radius of the site, in the Parkwood Formation, the Floyd Shale; the Bangor Limestone; the Hartselle Sandstone; the Pride Mountain Formation; The Tuscumbia Limestone, Fort Payne Chert, and Maury Formation; the Chattanooga Shale and Frog Mountain Sandstone; The Red Mountain Formation; The Chickamauga Limestone; the Knox Group undifferentiated, the Ketona Dolomite, and the Conasauga Formation (Ref. 12 Maps 14, 15, 21, 22). Together, these units represent an aggregate thickness of over 10,000 feet of sediment. The presence and thickness of any particular rock unit is dependent on its location within this complex structural setting. Extensive faulting and folding has exposed at land surface the previously mentioned formations (Ref. 9 pp. 7-13).

Water bearing rock units underlying the facility, in descending order, include the outcropping Knox Group undifferentiated, the Ketona Dolomite, and the Conasauga Formation (Ref. 12 Map 21). Each of these units have different hydrologic characteristic and are considered as separate aquifers. They are however hydraulically connected and can be considered as a single aquifer system (Ref. 9 pp 37-40). The Knox Group is a cherty dolomite that outcrops at the facility and varies in thickness from 1500 to 2000 feet (Ref. 12 p. 3). It is not considered to be a good aquifer in the area although yields from springs within the Knox Group indicate that large quantities of water may be available (Ref. 9 p. 40). The subjacent Ketona Dolomite is characterized to be a good aquifer in the area and it's thickness ranges from 400 to 600 feet. The Conasauga Formation is considered to be a good aquifer in the area. The beds within the Conasauga Formation dip steeply and contain well developed solution features capable of producing large quantities of water (Ref. 10 pp 96-97).

Groundwater supplies in Jefferson County are primarily derived from rock units having well-developed water bearing solution and structural features. Within a 4-mile radius of the facility, the Fort Payne chert-Tuscumbia Limestone aquifer and the Bangor Limestone aquifer are considered to have the greatest potential for development as a groundwater resource. These aquifers currently sustain large volume production wells (Ref. 9 pp 41-42). However, these aquifers are not present in the immediate vicinity of the facility (Ref. 12 Maps 13, 14, 21, 22).

The Birmingham municipal water system supplies water to an area that extends beyond a 4-mile radius centered at the Sirco Systems facility (Ref. 13). No residents within the entire 4-mile radius were found to rely on groundwater (Refs. 13, 14). The Birmingham water system obtains water from the following three main surface water sources: the Cahaba River intake at Elmore Lake, located approximately 7.5 miles southeast of the Sirco Systems facility; Smith Lake, located approximately 36 miles northwest of the facility; and Inland Lake, located approximately 29 miles northeast of the Sirco Systems facility (Refs. 13, 15). Water is also withdrawn from Lake Purdy when water levels are too low to withdraw from the Cahaba River (Refs. 13).

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The Sirco Systems facility lies on a very flat tract of land and most of the precipitation is confined to the facility until evaporation or infiltration occurs. Any surface water runoff would likely flow east of the facility into a tributary of Village Creek, or South into Valley Creek. Village Creek is used primarily for industrial and wastewater effluent (Ref. 14).

The absence of any onsite disposal practices and targets removes the potential for any onsite, air, surface water, or groundwater migration pathways. Based upon the enclosures and the above, referenced material, no further remedial action planned is recommended at the Sirco Systems facility. If you have any questions regarding this facility feel free to contact me at NUS.

Yery/truly yours,

John W. Jenkins Geologist

JWJ/dwf

Enclosures

Approved:

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REFERENCES

- 1. EPA Notification of Hazardous Waste Site (EPA Form 8900-1) for SIRCO Systems, Inc., Birmingham, AL. Filed by Lawrence C. Tropea, Jr., past owner, June 9, 1981.
- 2. Potential Hazardous Waste Site Preliminary Assessment (EPS Form 3012-II) Telephone Log Sheet. Documentation of telephone call to Ed Cain, SIRCO Systems, Inc. by Will Warren, EPS, on August 1, 1984. Subject: Ownership of and hazardous waste activity at SIRCO Systems, Inc.
- 3. Potential Hazardous Waste Site Preliminary Assessment (EPA Form 3070-12) Industrial Narrative Sheet (EPS Form 3012-III) concerning SIRCO Systems, Inc., Birmingham, AL.
- 4. David L. Roberson, Environmentalist, interoffice memorandum to Bernard E. Cox, Jr., Chief, Hazardous and Industrial Waste Section, Alabama Department of Public Health, June 2, 1981. Subject: Waste materials at SIRCO Systems, Inc.
- 5. Kathryn F. Strang, Coordinator-Regulatory Affairs, Quaker Chemical Corporation, Conshohocken, PA, letter to Louis Faust, Purchasing Manager, SIRCO Systems, Inc., April 30, 1981. Subject: Enclosure of Material Safety Data Sheets for products of interest.
- 6. Joe Brewer, interoffice memorandum to Harold Taylor, Alabama Department of Environmental Management, December 10, 1982. Subject: Hazardous waste activity at SIRCO Systems, Inc.
- 7. Bernard E. Cox, Jr., Chief, Industrial and Hazardous Waste Section, Alabama Department of Environmental Management, letter to James R. Hoagland, SIRCO Systems, Inc., September 26, 1984. Subject: Issuance of EPA ID No.
- 8. Potential Hazardous Waste Site Preliminary Assessment (EPS Form 3012-II) Telephone Log Sheet. Documentation of telephone call to Chuck Bent, Reynolds Metals Company, Richmond, VA by Will Warren, EPS on August 31, 1984. Subject: Confirmation of data on SIRCO Systems, Inc.
- 9. Tola B. Moffett and Paul H. Moser, "Groundwater Resources of the Birmingham and Cahaba Valleys of Jefferson County, Alabama, "Circular 103, (University, Alabama: Geological Survey of Alabama, 1978).
- 10. William Drumm Johnston, Jr. with Margaret D. Foster and C.B. Howard, "Groundwater in the Paleozoic Rocks of Northern Alabama, Part I--Text," <u>Special Report No. 16</u>, (University, Alabama: Geological Survey of Alabama, 1933).
- 11. U.S. Department of Commerce, <u>Climatic Atlas of the United States</u>, (Washington, D.C.: GPO, June 1968) Reprint: 1983, National Oceanic and Atmospheric Administration.
- 12. Jack T. Kidd with Karen E. Ritcher. "Areal Geology of Jefferson County, Alabama," <u>Atlas 15</u>, (University, Alabama: Geological Survey of Alabama, 1979).
- 13. NUS Corporation Field Logbook No. F4-819 for SIRCO Systems, Inc., TDD No. F4-8804-53, pp. 1-6. Documentation of facility reconnaissance, March 25-26, 1988.
- 14. Joe Downey, Alabama Department of Environmental Management, telephone conversation with Stephen Modica, NUS Corporation, May 23, 1988. Subject: Industrial, municipal, and private water sources in Birmingham area.

 U.S. Geological Survey, 7.5 minute series Topographic Quadrangle Maps of Alabama: Birmingham North 1959 (Photorevised 1970, 1978), Cahaba Heights 1959 (PR 1970, 1978), Remlap 1960 (PR 1986), Sunlight 1949, Irondale 1959 (PR 1978), Pinson 1959 (PR 1970), Argo 1959 (PR 1970), Cold Springs 1949 (PR 1978), Sipsey 1949 (PR 1978), Creek 1951 (PR 1978), Brookside 1959 (PR 1970), scale 1:2400.



Potential Hazardous Waste Site

Site Inspection Report

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Site Inspection Report

SEPA	
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POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT ART 1 - SITE LOCATION AND INSPECTION INFORMATION

L IDENT	PICATION
	02 SITE NUMBER
AL	ALD054563887

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Chuck Bear				ad St. Palmad VAZSZ	1904 281-2918
GARY PANder	(51100)	Plant Foreman Assistant Plant			12051 254 -353
Bill PAtterson	(Sicco)	Assistant Plant MANAGEY	,, ,,		(")"
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IV. INFORMATION AVAILAB	LE FROM	7			
01 CONTACT		OR OF (Agency/Organization)			OS TELEPHONE NO.
John Jenkins	TE INSPECTION FORM	NUS	MEANGEATION	(404)-938-7710	OG DATE O 1101 8 9 MONTH DAY YEAR

&EPA	
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POTENTIAL HAZARDOUS WASTE SITE

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01 STATE	02 SITE NUMBER
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SITE INSPECTION REPORT PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS		YENTS		LD 05456388
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01 A GROUNDWATER CONTAMINATION 03 POPULATION POTENTIALLY AFFECTED:	02 () OBSERVED (DATE:) /	OTENTIAL	□ ALLEGED
Potential if Drums leak				
01 - B. SUPFACE WATER CONTAMINATION 03 POPULATION POTENTIALLY AFFECTED:	02 OBSERVED (DATE:) O P	OTENTIAL	C ALLEGED
N. A				
01 C. CONTAMINATION OF AIR 03 POPULATION POTENTIALLY AFFECTED:	02 COMERVED (DATE:)	OTENTIAL	□ ALLEGED
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01 [] D. PINE/EUPLOGIVE CONDITIONS	02 C COREFIVED (DATE:	\ E P	OTENTIAL.	ALL ROED
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01 E. DIRECT CONTACT 03 POPULATION POTENTIALLY AFFECTED:	02 GENERATE (DATE:	1 /	OTENTIAL	ALLEGED
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01 F. CONTAMINATION OF SOIL 03 AREA POTENTIALLY AFFECTED:	OR COMERVED (DATE:	.) <u>A</u> b	OTENTAL	□ ALLEGED
Potential if Drums leak				
01 G. OFFINING WATER CONTAMINATION 03 POPULATION POTTENTIALLY APPECTED.	02 COSSENAD (DATE:	.) DP	OTENTAL.	□ ALLEGED
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01 [] I. POPULATION EXPOSURE/INJURY 03 POPULATION POTENTIALLY AFFECTED:

POTENTIAL HAZARDOUS WASTE SITE

L DENTIFICATION

PART 3 - DESCRIPT	SITE INSPECTION REPORT 10N OF HAZARDOUS CONDITIONS AND INCIDEN	AL A	LD054563887
IL HAZARDOUS CONSTITIONS AND INCIDENTS	Continued		
01 II J. DAMAGE TO PLORA 04 NARRATIVE DESCRIPTION	O2 CI COSCERVED (DATE:)	POTENTIAL	□ ALLEGED
WAA	UNKnown		
01 K. DAMAGE TO FAUNA 04 NARRATIVE DESCRIPTION (module namera) of species)	O2 CORRENVED (DATE:)	□ POTENTIAL	ALLEGED
Unknown			
01 DL CONTAMINATION OF FOOD CHAIN 04 NARRATIVE DESCRIPTION	02 COSSERVED (DATE:)	□ POTENTIAL	☐ ALLEGED
N. A.			
01 M. UNSTABLE CONTAINMENT OF WASTES	OZ CORRENVED (DATE:)	- POTENTIAL	- ALLEGED
03 POPULATION POTENTIALLY AFFECTED:	G4 NAMPATIVE DESCRIPTION		
N. A.			
Q1 N. DAMAGE TO OFFSITE PROPERTY Q4 NAME THE DESCRIPTION	O2 OGGERVED (DATE:)	- POTENTIAL	C ALLEGED
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01 O. CONTAMINATION OF SEWERS, STORM DRA	INS, WWTPs 02 COSSERVED (DATE:)	- POTENTIAL	G ALLEGED
N.A.			
01 - P. ILLEGAL/UNAUTHORIZED DUMPING 04 NARRATIVE DESCRIPTION	02 C OBSERVED (DATE:)	- POTENTIAL	☐ ALLEGED
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06 DESCRIPTION OF AME GREEN WHOMA, POTTERTS	N., OR ALLEGED HAZARDS.		
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IV. COMMENTS			
V. SOURCES OF INFORMATION (Cts aposite responses	. G. g., state fibe. sample analysis. reports		
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&EPA		POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION PART 4 - PERMIT AND DESCRIPTIVE INFORMATION				
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01 TYPE OF PERMIT ISSUED (Chook all that apply)	02 PERMIT NUMBER	G3 DATE ISSUED	04 EXPENATION DATE	06 COMMENTS		
A. NPOES						
□ B. UIC						
C.C. AIR			_		. .	
D. FICRA						
☐ E. RCRA INTERIM STATUS						
☐ F. SPCC PLAN						
G. STATE Books						
☐ H. LOCAL (Speedy)						
(I. OTHER (Seed))	EPA Generator	I.D. Number	m 1984 -	Numberi	Dates unknown	
□ J. NONE		<u>. l</u>		<u> </u>		
M. SITE DESCRIPTION						
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E. TANK, BELOW GROUND			BIOLOGICAL WASTE OIL PROCES		OS AREA OF SITE	
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☐ H. OPEN DUMP		OH.	OTHER			
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V. CONTAINMENT						
1 CONTARGMENT OF WASTES (Cheef ana)	V			, , <u>, , , , , , , , , , , , , , , , , </u>		
A. ADEQUATE, SECURE	S. MODERATE	C. INADEQU	MTE, POOR	☐ D. PHESC	URE, UNGOUND, DANGEROUS	
2 DESCRIPTION OF DRUMS, ORGAN, LIMEN	A. GAVANIDA, ETC.					
V. ACCESSIBILITY						
OI WASTE EASELY ACCESSIBLE: 102 COMMENTS	res pro					
/L SOURCES OF INFORMATION (C	e aposalle references, e.g. state flos, se	origina analysis, reports)				
Reconnaissance Lo						

&EPA			SITE INSPEC	ROOUS WASTE TION REPORT IC, AND ENVIRO		LIDENTIFICATION OF STATE OF SITE NUMBER AL ALDOS456388
IL DRINKING WATER SUP	ALY .		T			T
01 TYPE OF DRINKING SUPPLY (Cheek as applicable)			02 STATUS			OS DISTANCE TO SITE
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ML GROUNDWATER						
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06 POPULATION WITHIN VICINITY	OF SITE (4		عناك مظاهده أو والتلام أ			
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VI. ENVIRONMENTAL SAMATION	9- WAIEN, VERTOGRAPI	IIV, AND ENVIRON	MENIAL VAIA	
O1 PERMEABILITY OF UNBATOMATED ZONE (Choose on A. 10 ⁻⁶ 10 ⁻⁸ onvised	Worst possible c	nse, but Not F C. 10-4 - 10-3 and	OCO DO GREATER	THAN 10 ⁻³ cm/sec
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11 DISTANCE TO WETLANDS IS now minimum; RETUARINE	OTHER	18 DISTANCE TO CRITIC		
13 LAND USE IN VICINITY DISTANCE TO: COMMERCIAL/INDUSTRIAL	RESIDENTIAL AREAS: NATIO PORSETS, OR WILDLE		FROME AND UN	CULTURAL LANCE MELAND
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This facility water is supplied groundwater are is absence of any any contamination.	to located in to recidents was used for dispills or leaks	to get an acc	orale god	•
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NUS Recon Log Climatic Atlas Panufall Frequency Atlas of	book F4-81 F He U.S.	(

&EPA	H.		OTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT ART 6 - SAMPLE AND FIELD INFORMATION	OF STATE OF S	ATION BITE NAMES DOS4563887	
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RUNOFF						
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SOL						
VEGETATION						
OTHER						
M. FIELD MEASUR	EMENTS TA	KAN			Š	
O1 TYPE		OÈ COMMENTS				
				<u></u>		
IV. PHOTOGRAPH	S AND MAPS					
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03 MAPS	04 LOCATION	OF WAPS	<u> </u>			
□ NO						
V. OTHER FIELD D	ATA COLLE	TED months remains are				
VI. SOURCES OF I	NFORMATIO	N /Cito apositis retornosas, s.	g., state files, semple analysis, reports)			

≎EP ⁄		· ·	PO [·]	SITE INSPEC	RDOUS WASTE SIT TION REPORT IR INFORMATION		LIDENTY OLSTATE O AL	2 317	
IL CURRENT OW	NERCE)				PARENT COMPANY	f application			
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	POTENTIAL HAZARDOUS WASTE SITE		L IDENTIFICATION			
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	POTENTIAL HAZARDOUS WASTE SITE		L IBENTIFICATION
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IL PAST RESPONSE ACTIVITIES			
01 A WATER SUPPLY CLOSED 04 DESCRIPTION	OS DATE	03 AGENCY	
01 G. TEMPORARY WATER SUPPLY PROVID 04 DESCRIPTION	ED 02 DATE	OS AGENCY	
01 C. PERMANENT WATER SUPPLY PROVIDE 04 DESCRIPTION	ED 02 DATE	03 AGENCY	
01 D. SPILLED MATERIAL REMOVED 04 DESCRIPTION	02 DATE	09 AGENCY	
01 E. CONTAMINATED SOIL REMOVED 04 DESCRIPTION	OZ DATE	09 AGENCY	400
01 C F. WASTE REPACKAGED 04 DESCRIPTION	OZ DATE	OS AGENCY	
01 (2 WASTE DISPOSED ELSEWHERE 04 DESCRIPTION	CE DATE	OB ASSICY	
01 () M. ON SITE BUFIAL 04 DESCRIPTION	OR DATE	OS ASSICY	
01 (2 I. IN SITU CHEMICAL TREATMENT 04 DESCRIPTION	OE 0A7E	OS ASSENCY	
01 [] J. IN SITU BIOLOGICAL TREATMENT 04 DESCRIPTION	GE DATE	OS AGENCY	
01 C K. IN SITU PHYSICAL TREATMENT 04 DESCRIPTION	QE DATE	00 AGENCY	
et D. BICAPULATION 04 DESCRIPTION	OR DAYE	GO AGENCY	
01 G & 1 G & 2 G &	OR DATE	03 AGENCY	
01 D (A)A 04 0m2 0m3	02 DATE	OB AGENCY	
01 (O. EMERGENCY DIKING/SUPFACE WATER 04 DESCRIPTION	R DIVERSION 02 DATE	09 AGENCY	
01 P. CUTOPF TRENCHER/SUMP 04 DESCRIPTION	02 DATE	09 AGENCY	
01 [] Q. SUBSURFACE CUTOFF WALL 04 DESCRIPTION	02 DATE	03 AGENCY	

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SEPA ALA	POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT		OI STATE OF SITE NAMED AL ALD 054563887
24.10	PART 10 - PAST RESPONSE ACTIVITIES		AL THU034563887
II PAST RESPONSE ACTIVITIES (Continue)			
01 R. BARRIER WALLS CONSTRUCTED 04 DESCRIPTION	OR DATE	03 AGENCY	 :
01 S. CAPPING/COVERING 04 DESCRIPTION	OR DATE	03 AGENCY.	
01 T. BULK TANKAGE REPAIRED 04 DESCRIPTION	OE DATE	OS AGENCY.	
01 D. GROUT CURTAIN CONSTRUCTED 04 DESCRIPTION	Q2 GATE	OS AGENCY.	
01 () V. BOTTOM SEALED 04 DESCRIPTION	OR DATE	OS AGENCY.	
01 () W. GAS CONTROL 04 DESCRIPTION	OE DATE	OS AGENCY.	å
01 (2 X. FIRE CONTROL) 04 DESCRIPTION	GE DATE	OB AGENCY.	
01 Y. LEACHATE TREATMENT 04 DESCRIPTION	OR DATE	OB AGENCY.	
01 - Z. AREA EVACUATED 04 DESCRIPTION	GE CATE	09 AGENCY.	
01 1. ACCESS TO SITE RESTRICTED 04 DESCRIPTION	02 9A7E	09 AGENCY	
01 © 2. POPULATION RELOCATED 04 DESCRIPTION	OZ SATE	09 AGENCY.	
61 (3. OTHER REMEDIAL ACTIVITIES OF DESCRIPTION	OR BATE	09 AGENCY.	
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III. SOURCES OF INFORMATION (Che seculo retar	Orlead, e.g., alate files, auritale enalysis, reporte)		



POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT PART 11 - ENFORCEMENT INFORMATION

L IDENTIFICATION

01 STATE OR SITE NUMBER

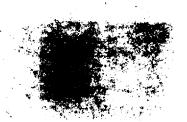
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IL ENFORCEMENT INFORMATION

01 PAST REGULATORY/ENFORCEMENT ACTION 🗆 YES 🗆 NO

02 DESCRIPTION OF FEDERAL, STATE, LOCAL REGULATORY/ENFORCEMENT ACTION

N.A.



III. SOURCES OF INFORMATION (CIN specific references, e.g., materiles, autopie analysis, reports)

POTENTIAL HAZARDOUS WASTE SITE SITE INSPECTION REPORT

General Information

The Potential Hazardous Waste Site, Site Inspection Report form is used to record information collected during, or associated with, an inspection of the site and other information about responsible parties and past response activities.

The Site Inspection Report form contains eleven parts:

- Part 1 Site Location and Inspection Information
- Part 2 Waste Information
- Part 3 Description of Hazardous Conditions and Incidents
- Part 4 Permit and Descriptive Information
- Part 5 Water, Demographic, and Environmental Data
- Part 6 Sample and Field Information
- Part 7 Owner Information
- Part 8 Operator Information
- Part 9 Generator/Transporter Information
- Part 10- Past Response Activities
- Part 11 Enforcement Information
- Part 1 Site Location and Inspection Information contains all of the data elements also contained on the Site Identification and Preliminary Assessment forms required to add a site to the automated Site Tracking System (STS). It is therefore possible to add a site to STS at the Site Inspection stage. Instructions are given below.
- Part 2 Waste Information and Part 3 Description of Hazardous Conditions and Incidents are used to record specific information about substances, amounts, hazards, and targets, e.g., population potentially affected. Parts 2 and 3 are also contained in the Potential Hazardous Waste Site, Preliminary Assessment form. Information recorded on Part 2 and Part 3 during a preliminary assessment may be updated, added, deleted, or corrected on the Site Inspection Report form.

An Appendix with feedstock names and CAS Numbers and the most frequently cited hazardous substances and CAS Numbers is located behind the instructions for the Site Inspection Report.

A number of the day have collected throughout the Site Inspection Report supplies his Site Ranking Model. The majority of these data items to found in Part 5 — Water, Demographic, and Environmental Data.

General Instructions

- Complete the Site Inspection Report form as completely as possible.
- 2. Starred items (*) are required before inspection information can be added to STS. The system will not accept incomplete inspection information.
- 3. To add a site to STS at the Site Inspection stage, write "New" across the top of the form and complete items II-01, 02, 03, 04, and 06, Site Name and Location, II-09 Coordinates, and II-10, Type of Ownership.
- 4. Data items carried in STS, which are identical to those on the Site Identification and Preliminary Assessment forms and which can be added, deleted, or changed using the

Site inspection Report form, are indicated with a pound sign (#). To ensure that the proper action is taken, outline the item(s) to be added, deleted, or changed with a bright color and indicate the proper action with "A" (add), "D" (delete) or "C" (change).

5. There are two options available for adding, deleting, or changing information supplied on the Site Inspection Report form. The first is to use a new Site Inspection Report form, completing only those items to be added, deleted, or changed. Mark the form clearly, using "A", "D", or "C", to indicate the action to be taken. If only data in STS are to be altered, the Site Source Data Report may be used. Using the report, mark clearly the items to be changed and the action to be taken.

Detailed Instructions

Part 1 Site Lesstion and Inspection Information

- I. Identification: Identification (State and Site Number) is the site record key, or primary identifier, for the site. Site records in the STE are updated based on Identification. It is essential that State and Site Number are correctly entered; on each form.
 - *I-01 State: Enter the two character alpha FIPS code for the state in which the site is located. It must be identical to State on the Site Identification form.
- "I-02 Site Number: Enter the ten character alphanumeric code for sites which have a Dun and Bradstreet or EPA "user" Dun and Bradstreet number or the ten character numeric GSA identification code for federal sites. The Site Number must be identical to the Site Number on the Site Identification and Preliminary Assessment forms.
- II. Site Name and Location: If Site Name and Location information require no additions or changes, these items are not required on the Site Inspection Report form. However, completing these items will facilitate use of the completed form and records management procedures.
- #II-01 Site Name: Enter the legal, common, or descriptive name of the site.
- #II-02 Site-Street: Enter the street address and number (if appropriate) where the site is located. If the precise street address is unavailable for this site, enter brief direction identifier, e.g., NW Jct I-295 & US 99; Post Rd, 5 mi W of Rt. 5.
- atti-03 Site City: Enter the city, town, village, or other municipality in which the site is located. If the site is not located in a municipality, enter the name of the municipality (or place) which is nearest the site or which most easily locates the site.
- #II-04 Site State: Enter the two character alpha FIPS code for the state in which the site is located. The code must be the same as in-item I-01.
- #11-05 Site Zip Code: Enter the five character numeric zip code for the postal zone in which the site is located.

- #11-06 Site County: Enter the name of the county, perish
- (Louitienet, or barough (Alaska) in which the site is leasted.

 #II-07 County Coder error the three character numeric FIPS county code for the county, perish, or borough in which the classic for the county. ough in which the site is located. (The regional data analyst can furnish this data item.)
- #11-08 Site Congressional District: Enter the two character number for the congressional district in which the eita is located
- *#11-09 Coordinates: Enter the Coordinates, Latitude and Longitude, of the site in degrees, minutes, seconds, and tenths of seconds. If a tenth of a second is insignificant at this site, enter "O" in the tenths position.
- #II-10 Type of Ownership: Check the appropriate box to indicate the type of site ownership. If the site is under the jurisdiction of an activity of the federal government, enter the name of the department, agency, or activity. If Other is indicated, specify the type of ownership and name.
- III. Inspection Information
 - *III-01 Date of Inspection: Enter the date the inspection occurred, or began for multiple day inspections.
 - "III-02 Site Status: Check the appropriate box(es) to indicate the current status of the site. Active sites are those which treat, store, or dispose of wastes. Check Active for those active sites with an inactive storage or disposal area. Inactive sites are those at which trestment, storage, or disposal activities no longer
- #11-03 Years of Operation: Enter the beginning and ending years (or beginning only if operations at the site are on-going), e.g., 1878/1932, of sits operation. Check Unknown if years of operation are not known,
- *III-04 Agency Performing Inspection: Check the appropriets box(es) to indicate particle participating in the inspection. If contractors participate, provide the name of the firm(s).
- 111-05 Chief Inspector: Enter the name of the chief, or leed inspectors
- title, e.g., Team III-06 Title: Enter Leeder, FIE
- Me name of the organization 111-07 Organizat where the Region 4 Health Dant., Environmental
- III-08 Telephone Number: Enter the Chief Inspector's area code and local commercial telephone number.
- 111-09 Other Inspectors: Enter the names of other parties perticipating in the inspection.
- III-10 Title: Enter the titles of other parties participating in the inspection.
- 111-11 Organization: Enter the names of the organizations where other parties participating in the inspection are employed.
- 111-12 Telephone Number: Enter the area code and local commercial telephone numbers of other parties perticipating in the inspection.

- III-13 Site Representatives Interviewed: Enter the names of individuals representing responsible parties interviewed in connection with the inspection, Interviews do not necessarily occur during the inspection.
- 111-14 Title: Enter the titles of the individuals interviewed.
- 111-15 Address: Enter the business, mailing, or residential addresses of the individuals interviewed.
- 111-16 Telephone Number: Enter the area code and local commercial telephone numbers of the individuals interviewed.
- 111-17 Access Gained By: Check the appropriate box to indicate whether access to the site was gained through permission or warrant.
- III-18 Time of Inspection: Using a 24-hour clock, enterthe time the inspection began, e.g., for 3:24 p.m.
- 111-19 Weether Canditions: Describe the weether conditions during the site inspection, especially any unusual conditions which might affect results or obser-1, 2 vetions taken.
- Information Available From
 - IV-01 Contact: Enter the name of the individual who can provide information about the site
 - IV-02 Of: If appropriate, enter the name of the public or private agency, firm, or company and the organization within the agency, firm, or company of the individual named as Contact.
 - IV-03 Telephone Number: Enter the area code and local telephone number of the individual named as contest.
 - IV-04 Person Responsible for Sits Inspection Report Form: Enter the name of the individual who was responsible for the information entered on the Site Inspection Report form. The person responsible for the Site Inspection Report form may be different from the individual who prepared the form.
 - IV-05 Agency: Enter the name of the Agency where the individual who is responsible for the Site Inspection -- Report form is employed.
 - IV-06 Organization: Enter the name of the organization within the Agency.
 - IV-07 Telephone Number: Enter the area code and local telephone number of the individual who is responsible for the Site Inspection Report form.
 - IV-08 Date: Enter the date the Site Inspection Report form was prepared.

Wests Information Port 2

- Identification: Refer to Part 1-1. •1.
- Weste States, Quantities, and Characteristics: Waste It. States, Quantities, and Characteristics provide informetion about the physical structure and form of the waste, measures of gross amounts at the site, and the hazards posed by the wasts, considering acute and chronic health effects and mobility along a pethwey.

- "II-01 Physical States: Check the appropriate box(es) to indicate the state(s) of waste present at the site. If Other is indicated, specify the physical state of the waste.
- *11-02 Waste Quantity at Site: Enter estimates of amounts of waste at the site. Estimates may be in weight (Tons) or volume (Cubic Yards or Number of Drums). Use as many entries as are appropriate; however, measurements must be independent. For example, do not measure the same amounts of waste as both tons and cubic yards.
- *II-03 Waste Characteristics: Check all appropriate entries to indicate the hazards posed by waste at the site. If waste at the site poses no hazard, check Not Applicable.
- III. Waste Category: General categories of waste typically found are listed here. Enter the estimated gross amount of each category of waste and the appropriate unit of measure.
 - "III-01 Gross Amount: Gross Amount is the estimate of the amount of the waste category found at the site. Estimates should be furnished in metric tone (MT), tone (TN), cubic meters (CM), cubic yards (CY), drums (DR), acres (AC), acre feet (AF), Hters (LT), or gallons (GA). Enter the estimated amount next to the appropriate waste category.
 - *III-02 Unit of Messure: Enter the appropriate unit of messure, MT (metric tons), TN (tons), CM (cubic meters), CY (cubic yards), DR (number of drums), AC (acres), AF (acre feet), LT (liters), or GA (gallons) next to the estimate of gross amount.
 - III-03 Comments: Comments may be used to further explain, or provide additional information, about perticular waste categories.
- IV. Hezerdous Substances: Specific hezerdous, or potentially hezerdous, chemicals, mixtures, and substances found at the site are listed here. For each substance listed those data items marked with an "at" sign (©) must be included.
- OIV-01 Category: Enter in front of the substance name the three character waste cotegory from Section III which best design of substance a.e., OLW (Oily Westel).
- OIV-02 Substance of the partition of the following: the name of the substance of the substance, or commercial name of the substance.
- OIV-03 CAS Number: Enter the number assigned to the substance when it was registered with the Chemical Abstract Service. Refer to the Appendix for most frequently cited CAS Numbers. CAS Numbers must be furnished for each substance listed. If a CAS Number for this substance has not been assigned, enter "999".
- •IV-04 Storaga/Disposal Method: Enter the type of storage or disposal facility in which the substance was found: SI (surface impoundment, including pits, ponds, and lagoons), PL (pile), DR (drum), TK (tank), LF (landfill), LM (landfarm), OD (open dump).

- IV-06 Concentration: Enter the concentration of the substance found in samples taken at the site.
- IV-06 Measure of Concentration: Enter the appropriate unit of measure for the measured concentration of the substance found in the sample, e.g., MG/L, UG/L.

V. Feedstocks

- V-01 Feedstock Name: If feedstocks, or substances derived from one or more feedstocks, are present at the site, enter the name of each feedstock found. See the Appendix for the feedstock list.
- V-02 CAS Number: Enter the CAS Number for each feedstock named. See the Appendix for feedstock CAS Numbers.
- VI. Sources of Information: List the sources used to obtain information for this form. Sources cited may include: sample analysis, reports, inspections, official records, or other documentation. Sources cited provide the basis for information entered on the form and may be used to obtain further information about the site.
- Part 3 Description of Hazardous Conditions and Incidents
- *I. Identification: Refer to Part 1-1.
- II. Henerdous Conditions and Incidents:
 - 11-01 Hezerds: Indicate each hezerdous, or potentially hezerdous, condition known, or claimed, to exist at the site.
 - 11-02 Observed, Potential, or Allegad: Check Observed and enter the date, or approximate date, of occurrence if a release of contaminants to the environment, or some other hazardous incident, is known to have occurred. In cases of a continuing release, e.g., groundwater contamination, enter the date, or appreximate date, the condition first became apparent. If conditions exist for a potential release, check potential. Check Allegad for hazardous, or potentially hazardous, conditions claimed to exist at the site.
 - H-88- Pepulation Potentially Affected: For each hazardess condition at the site, enter the number of people potentially affected. For Soil enter the number of acres potentially affected.
 - II-04 Narrative Description: Provide a narrative description, or explanation, of each condition. Include any additional information which further explains the candition.
 - II-05 Description of Any Other Known, Potential, or Alleged Hezerds: Provide a narrative description of any other hezerdous, or potentially hezerdous, conditions at the site not covered above.
 - its. Total Population Potentially Affected: Enter the total number of people potentially affected by the existence of hazardous, or potentially hazardous, conditions at the site. Do not sum the numbers shown for each condition.
- IV. Comments: Other information relevant to observed, potential, or alleged hazards may be entered here.

- V. Sources of Information: List the sources used to obtain information for this form. Sources cited may include: sample analysis, reports, inspections, official records, or establishmentation. Sources cited provide the basis of information entered on the form and may be used to obtain further information about the site.
- Part 4 Permit and Descriptive Information
- *I. Identification: Refer to Part 1-1.
- II. Permit Information
 - II-01 Type of Permit Issued: Check the appropriate box(es) to indicate the types of permits issued to the site. If state, local, or other types of environmental permits have been issued, specify the type.
 - II-02 Permit Number: Enter the permit number for each issued permit.
 - 11-03 Date Issued: Enter the date each permit was issued.
 - II-04 Expiration Date: Enter the date each permit expires or expired.
 - II-05 Comments: Enter any information which further explains the types of permits issued or status of the permits.

III. Site Description

- *III-01 Storage/Disposal: Check the appropriate box(es) to indicate the types of storage/disposal facilities found at the site. If Other is checked, specify the type of facility.
- *III-02 Amount: Enter the gross amount of waste associated with each type of storage/disposal facility.

 Amounts may be measured in: metric tons, tone, cubic meters, cubic yards, drums, acres, acre feet, liters, or gallons.
- "III-03 Unit of Measure: Enter the appropriate unit of measure for each entry. Units of measure are MT (metric tons), TN (tons), CM (aubic meters), CY (aubic yards), DR (drums), AC (acres), AF (acre feet), LT (liters), or GA (gallons).
- "III-04 Treatment: If wests is treated at the site, check the appropriated box(es) to indicate treatment methods used. If Other is checked, specify treatment method.
- 111-05 Other: If there are the same and a stack this box
- *III-06 Area of Site: Engage and the life in sares.
- 111-07 Comments: Entire Programment Information.
- IV. Containment: Containment is a significant of the natural or artificial states taken to minimize or preclude health hazards and to minimize or prevent contamination of the environment from waste at the site.
- *IV-01 Containment of Wastes: Check the appropriate box to indicate the condition of containment measures at the site. When choosing the appropriate box, consider the potential for environmental contamination, i.e., the worst case for containment in conjunction with the most hazardous substances.
- IV-02 Description of Drums, Diking, Liners, Barriers: Provide a narrative description of the condition of containment measures at the site, e.g., waste ade-

- quetally contained, drums rusting and leaking, diking collepsing, liners leaking and contaminants leaching into soil and groundwater.
- V. Accessibility: Accessibility is an indicator of the potential for direct contact with hazardous substances.
 - *V-01 Waste Easily Accessible: If there are no real barriers preventing human access to hazardous waste, check Yes, otherwise check No.
 - V-02 Comments: Additional Information about accessibility to hazardous waste may be provided.
- VI. Sources of Information: List the sources used to obtain information for this form. Sources cited may include: sample analysis, reports, inspections, official records, or other documentation. Sources cited provide the basis for information entered on the form and may be used to obtain further information about the site.
- Part 5 Water, Demographic, and Environmental Data
 - *I. Identification: Refer to Part 1-1.
 - II. Drinking Water Supply
 - II-01 Type of Drinking Weter Supply: Check the appropriate box(es) to indicate the types and sources of drinking water within the vicinity of the \$10. Community refers to municipal sources. Non-community refers to private sources, e.g., private wells.
 - II-02 Status: Check the appropriate box(ss) to indicate whether the water supply is endangered or affected by contaminants from the site. Check the appropriate box to indicate if the water supply is being monitored for possible contamination.
 - II-03 Distance to Site: Enter the distance in miles to the nearest tenth, hundredth, or thousandth (as needed to indicate the precision required) from the site to nearest drinking water source.

III. Groundwater

- 111-01 Groundweter Use in Vicinity: Check the appropriate bex to indicate groundwater use in the vicinity of the site. The concern is to indicate the seriousness of groundwater contamination from waste at the site. Only Source for Drinking indicates that current water sources are limited to wells in the vicinity of the site. Drinking: Commercial, Industrial, Irriastion indicates that aroundwater is used for drinking, but that other limited drinking sources are available and that no other sources for these additional uses are available. Commercial, Industrial, Irrigation indicates that groundwater is used for these purposes, but that limited other sources of water are available. Not used, Unuseable indicates that groundwater use in the area is not critical.
 - 111-02 Population Served by Groundwater: Enter the number of people served by groundwater in the vicinity of the site. Population for the purposes of the Site Inspection Report includes residents and daytime workers and students but excludes transients in the neighborhood or on local highways and roads. When estimating population from aerial photographs or other sources, the conversion factor is 3.8 persons for each dwelling unit or 3 persons per acre in rural areas.

- III-03 Distance to Nearest Drinking Water Well: Erner the distance in miles to the nearest tenth, hundredth, or thousand it is played to indicate the precision required) from the life to the nearest drinking water well.
- III-04 Depth to Groundwater: Enter the depth in feet to groundwater.
- III-05 Depth of Groundwater Flow: Enter the cardinal direction of groundwater flow, e.g., NNW.
- III-06 Depth to Aquifer of Concern: Enter the depth in feet to the aquifer of concern.
- III-07 Potential Yield of Aquifer: Enter the potential yield of the squifer in gallons per day.
- III-08 Sale Source Aquifer: Check the appropriate box to indicate the aquifer of concern is, or is not, a sale source aquifer.
- III-09 Description of Wells: Provide a narrative description of wells in the vicinity of the sits, including useage, depth, and location relative to population and buildings.
- III-10 Recharge Area: Check the appropriate box to indicate the site is located in a recharge area. Comments provide additional information on the recharge area.
- III-11 Discharge Area: Check the appropriate box to indicate the site is located in a discharge area. Comments provide additional information on the discharge area.

IV. Surface Water

- IV-01 Surface Water Use: Check the appropriate box to indicate surface water use in the vicinity of the site. The order of precedence is Reservoir, Recreation, Drinking Water Source; Irrigation, Economically Important Reserves; Commercial/Industrial; Not Currently Used.
- IV-02 Affected/Potentially Affected Bodies of Weter:
 Enter the names of bodies of surface weter affected, or potentially affected, by contaminents from the site. Liet the body of surface water nearest the site first. For each body of water check Affected if contaminents have been identified in samples of the water. Enter the chartest distance from the body of water to the class of the samples of the distance of the chartest that have been identified in samples of the precision real.

V. Demographie Committee Internation

- V-01 Total Population Technics: Enter the total population within one (1) miles, two (2) miles, and three (3) miles of the site. Distances are measured from site boundaries. Population for the purposes of the Site Inspection Report includes residents and daytime workers and students but excludes transients in the neighborhood or on local highways and roads. When estimating population from serial photographs or other sources, the conversion factor is 3.8 persons for each dwelling unit or 3 persons per acre in rural areas.
- V-02 Distance to Neerest Population: Enter in miles to the neerest tenth, hundredth, or thousandth (as needed to indicate the precision required) the dis-

- tance from the site boundary to the nearest population (one person minimum).
- V-03 Number of Buildings Within Two (2) Miles of Site:

 Enter the number of buildings within two miles from the boundaries of the site.
- V-04 Distance to Nearest Off-Site Building: Enter the distance in miles to the nearest tenth, hundredth, or thousandth (as needed to indicate the precision required) from the site boundary to the nearest off-site building.
- V-05 Population in Vicinity of Site: Provide a narrative description of the nature of the population within the vicinity of the site. Examples include rural area, small truck farms, urban industrial area, densely populated urban residential area.

VI. Environmental Information

- VI-01 Permeability of Unsaturated Zone: Check the appropriate box to indicate the permeability of the earth meterial above the water table in the vicinity of the site.
- VI-02 Permeability of Bedrock: Check the appropriate box to indicate the permeability of the bedrock in the vicinity of the site.
- VI-09 Depth to Bedrock: Enter the dipth to bedrock in
- VI-04 Depth of Contaminated Soil Zand: Enter the depth of the contaminated soil zone in fact.
- VI-05 Sell pH: Enter the pH of the soil in the vicinity of the site.
- VI-08 Net Precipitation: Enter net precipitation in inches. If net precipitation is not known, subtract the average evaporation figure on the U.S. National Weather Service map showing average annual evaporation in inches from the U.S. Environmental Data Service map showing mean annual precipitation.
- VI-67 One Year 24 Hour Rainfell: Enter in inches the figure for one year 24 hour rainfell.
- VI-GS Slepe: Enter the percentage of site slope, the direction of site sleps, and the percentage of the surreunding terrain everage slope.
- VI-09 'Plead Petential: Enter the boundary year for the flexibilities in which the site is located. Sites flooded annually are in a 1 (one) year floodplain. Other examples include 10, 20, 50, 100, 500, etc., indicating the probability of flooding within that time period.
- VI-10 Sits is on Sarrier Island, Coastal High Hazard Area, Riverine Floodway: If sits is located in one of these areas, sheck this box.
- VI-11 Distance to Wetlands: If applicable, enter the distance in miles to the nearest tenth, hundredth, or thousandth (as needed to indicate the precision required) from the site to the classest wetlands (five acre minimum) for Estuarine and Other types of wetlands.
- VI-12 Distance to Critical Habitat: If applicable, enter the distance in miles to the nearest tenth, hundredth, or thousandth (as needed to indicate the precision required) from the site to the nearest critical habitat

of an endangered species. Enter the name(s) of the endengered a de .

- VI-13 Land Use in Visit Clinter the distance in miles to the nearest turing buildredth, or thousandth (as needed to indicate the precision required) to the nearest Commercial/Industrial area; Residential Area, National/State Parks, Forests, or Wildlife Reserves; or Agricultural Lands, Prime Ag Land and Ag Land, Prime Ag Land is that crop, pasture, range, or forest land which produces the highest yield in relation to inputs. Ag Land is the remaining agricultural land, frequently considered marginal.
- VI-14 Description of Site in Relation to Surrounding Topography: Provide a narrative description of significant or unusual aspects of the surrounding topography in relation to the site. Examples might include: site is in a valley surrounded on all sides by mountains, site is at edge of a river or stream which floods frequently, etc.
- VII. Sources of Information: List the sources used to obtain information for this form. Sources cited may include: sample analysis, reports, inspections, official records, or other documentation. Sources cited provide the basis for information entered on the form and may be used to obtain further information about the site.

Sample and Field Information Part 6

•1. Identification: Refer to Part 1-1.

11. Samples Taken

- Number of Samples Taken: Next to each sample 11-01 type enter the number of samples of that type teken.
- 11-02 Samples Sent To: Enter the name of the laboratory or other facility where the samples were sent for
- 11-03 Estimated Data Results Available: Enter the estimeted date the results are expected to be available.

Field Measurements Takes 111.

- III-01 Type: Enter the type, e.g., radio estivity, explosivity, type sa
- murements, 111-02 Comments and if apoliwhether, f, e.g., drum,

IV. Photogra

- IV-01 Type: If photographs of the site have been taken, check the appropriate box(as) to indicate the type.
- IV-02 In Custody Of: Enter the name of the organization or person who has austody of the photographs.
- IV-03 Maps: Check the appropriate box to indicate that maps of the site area have been prepared or obtained.
- IV-04 Location of Maps: If site maps are available, indicate their location, e.g., Region 1 Air and Hazardous Materials Division.
- Other Field Data Collected: Provide a narrative de-V. scription of any other field data collected.

VI. Sources of Information: List the sources used to obtain information for this form. Sources cited may include: sample analysis, reports, inspections, official records, or other documentation. Sources cited provide the basis for information entered on the form and may be used to obtain further information. about the site.

Part 7 Owner Information

- •1. Identification: Refer to Part 1-1.
- Current Owner(s) Parent Company: Current 11. owner(s) and perent compenies, for those owners which are compenies partly or wholly owned by another company, provide locator information about responsible parties. Each Part 7 provides space for four (4) current owners and their respective parent compenies. If additional space is required, complete another Part 7.
 - Name: Enter the legal name of the owner of the 11.01 sits. The owner may be a firm, government agency, association, individual, etc.
 - 11-02 D&S Number: Where available, enter the owner's D&S (Dun and Bradstreet) number. If the current owner is a federal agency, enter the GSA Mentification code.
 - 11-03 Street Address: Enter the business, mailing or residential street address of the owner,
 - 11-04 SIC Code: If applicable, enter the owner's primary SIC Code.
 - 11-05 City: Enter the city of the owner's business, mailing, or residential address.
 - 11-06 State: Enter the two character alpha FIPS code for the state of the owner's business, mailing, or residential address.
 - 11-07 Zip Code: Enter the five digit zip code for the owner's business, mailing, or residential address.
 - 11-08 Name: If the owner is a partly or wholly owned subsidiary of another company, enter the legal name of the owner's perent company.
 - 11-08 D&B Number: Enter the perent company's Dun and Bradstreet number.
 - 11-10 Street Address: Enter the business or mailing street address of the parent company.
 - II-11 SIC Code: If applicable, enter the parent company's primery SIC code.
 - 11-12 City: Enter the city of the parent company's business or mailing address.
 - 11-13 State: Enter the two character alphe FIPS code for the state of the parent company's business or mailing address.
 - Zin Cade: Enter the five digit zip code for the perent company's business or mailing address.
- 111. Previous Owner(s): List previous owners in reverse chronological order, i.e., most recent first. If additional space is required, complete another Part 7.
 - 111-01 Name: Enter the legal name of the previous owner. The previous owner may have been a firm, government agency, association, individual, etc.

III-02 D&B Number: Enter the previous owner's Dun and Bradetreit. In the previous owner that I was a large of a liter the GSA identification code I

. 3;

- III-03 Street Address: It is the business, mailing, or residential street addition of the previous owner.
- 111-04 SIC Code: If applicable, enter the primary SIC Code of the previous owner.
- III-05 City: Enter the city of the previous owner's business, mailing, or residential address.
- 111-06 State: Enter the two character alpha FIPS code for the state of the previous owner's business, mailing, or residential address.
- III-07 Zip Code: Enter the zip code of the previous owner's business, mailing, or residential address.
- IV. Realty Owner(s): Realty owner applies when the owner lessed to another entity property which was used for the storage or disposal of hezardous waste.

 List current or most recent first.
 - IV-01 Name: Enter the legal name of the resity owner. The resity owner may be a firm, government agency, association, individual, etc.
 - IV-02 D&B Number: Enter the previous owner's Dun and Bradstreet number if available. If the previous owner was a federal agency, enter the GSA identification code if available.
 - IV-03 Street Address: Enter the realty owner's business, meiling, or residential street address.
 - IV-04 SIC Code: If applicable, enter the resity owner's primary SIC Code.
 - IV-05 City: Enter the city of the realty owner's business, meiling, or residential address.
 - IV-08 State: Enter the two character alpha FIPS code for the state of the resity owner's business, mailing, or residential address.
 - IV-07 Zip Code: Enter the zip code of the reality owner's business, mailing, or residential address.
- V. Scoress of Information: List to partnet used to obtain information and information information in Sources cited provide.

 The form and incommend to the form and incommend the sources of the sources

Part 8 Operator Information

- *1. Identification: Refer to Part 1-1,
- II. Current Operator—Operator's Parent Company: Information on operators is applicable when the operator is not the owner.
 - 11-01 Name: Enter the legal name of the operator. The operator may be a firm, government agency, association, individual, etc.
 - II-02 D&B Number: Enter the operator's Dun and Bradstreet number if available. If the operator is a federal agency, enter the GSA identification code if available.

- II-03 Street Address: Enter the operator's business, mailing, or residential street address.
- 11-04 SIC Code: If applicable, enter the operator's primary SIC Code.
- II-05 City: Enter the city of the operator's business, mailing, or residential address.
- II-06 State: Enter the two character alpha FIPS code for the state of the operator's business, mailing, or residential address.
- 11-07 Zip Code: Enter the zip code of the operator's business, mailing, or residential address.
- 11-06 Years of Operation: Enter the beginning and ending years (or beginning only if operations are on-going), e.g., 1932/1948, of operation at the site.
- 11-09 Name of Owner: Enter the name of the owner for the period cited for this operator.
- II-10 Name: If applicable, enter the legal name of the operator's parent company.
- II-11 D&B Number: Enter the operator's partial common Oun and Bradstreet number If available.
- II-12 Street Address: Enter the operator's pullint company business, mailing, or residential street decreas.
- 11-13 SIC Code: If applicable, enter the approximate parameter company primary SIC Code.
- 11-14 City: Enter the city of the operator's parent company business, mailing, or residential address.
- II-16 State: Enter the two cheracter elpha FIPS code for the state of the operator's parent company business, mailing, or residential address.
- II-16 Zip Code: Enter the zip code of the operator's person company business, mailing, or residential
- III., Philipia Cyperator(s)—Previous Operators' Perent
 - Iff M Name: Enter the legal name of the previous operater. The previous operator may be a firm, government agency, especiation, individual, etc.
 - III-GE DOM Mumber: Enter the previous operator's Dun and Bradstreet number if smileble. If the previous operator was a federal agency, enter the GSA identification code if smileble.
 - III-03 Street Address: Enter the previous operator's business, melting, or residential street address.
 - 111-04 SIC Code: If applicable, enter the previous operater's primary SIC Code.
 - 111-05 City: Enter the city of the previous operator's business, melling, or residential address.
 - III-08 State: Enter the two character alpha FIPS code for the state of the previous operator's business, mailing, or residential address.
 - 111-07 Zip Code: Enter the zip code of the previous operator's business, mailing, or residential address.
 - III-08 Years of Operation: Enter the beginning and ending years of operation for this operator at the site.
 - III-09 Name of Owner: Enter the name of the owner for the period cited for this operator.

- RE-10 Nees of the enter the legal name of the
- 111-11 D&B Jack Des State of All States of Sta
- III-12 Street Address. The previous operator's perent company business, mailing, or residential street address.
- III-13 SIC Code: If applicable, enter the previous operator's perent company primary SIC Code.
- 111-14 City: Enter the city of the previous operator's perent company business, mailing, or residential address.
- III-15 State: Enter the two cheracter alpha FIPS code for the state of the previous operator's parent company business, mailing, or residential address.
- III-16 Zip Code: Enter the zip code of the previous operator's perent company business, mailing, or residential address.
- IV. Sources of Information: List the sources used to obtain information for this form. Sources cited may include: sample analysis, reports, inspections, official records, or other documentation. Sources cited provide the basis for information entered on the form and may be used to obtain further information about the site.
- Part 9 Generator/Transporter Information
- *1. Identification: Refer to Part 1-1.
- II. On-Bite Generator: A company or agency, located within the contiguous area of the site and generating weste disposed on the site, is entered here.
 - II-01 Name: If there is an en-site generator, enter the legal name of the on-site generator. The en-site generator may be a firm or government agency.
 - 11-02 D&B Number: Where evaluate, enter the en-elte generator's D&S (Dyn and Brestmant) number, if the en-elte generator is a federal agency, enter the GSA identification tools.
 - II-03 Street Address William at malling street
 - 11-04 SIG principal state of the generator's principal state of the generator's
 - 11-05 City Comments of generator's buel-

 - 11-07 Zip Code: Enter the five digit zip code for the onsite generator's business or mailing address.
- III. Off-Site Generator(s): Those companies or agencies off-site who have generated waste which has been disposed at the site are listed here.
 - 111-01 Name: Enter the legal name of the off-site generator. The off-site generator may be a firm or government agency.
 - III-02 D&B Number: Where available, enter the off-site generator's D&B (Dun and Bradstreet) number. If the off-site generator is a federal agency, enter the GSA identification code.

- III-03 Street Address: Enter the business or mailing street address of the off-site generator.
- III-04 SIC Code: If applicable, enter the off-site generator's primary SIC Code.
- III-05 City: Enter the city of the off-site generator's business or mailing address.
- 111-06 State: Enter the two character alpha FIPS code for the state of the off-site generator's business or mailing address.
- III-07 Zip Code: Enter the five digit zip code for the offsite generator's business or mailing address.
- IV. Transporter(s): Those carriers who are known to have transported waste to the site are listed here.
 - IV-01 Name: Enter the legal name of the transporter. The transporter may be a firm, government agency, association, individual, etc.
 - IV-02 D& Number: Where available, enter the transporter's D&B (Dun and Bradistreet) number. If the transporter is a federal agency, sittler the GSA identification code.
 - iV-03 Street Address: Enter the building, instiling, or residential street address of the talking-order
 - IV-04 SIC Code: If applicable, entail the transporter's primary SIC Code.
 - IV-95 City: Enter the city of the transporter's business, melling, or residential address.
 - IV-05 State: Enter the two character alpha FIPS code for the state of the transporter's business, mailing, or residential address.
 - IV-07 Zip Code: Enter the five digit zip code for the transgentler's business, moliting, or residential address.
 - Indicate of information: List the sources used to obtain information for this form. Sources cited may include; semple enalysis, reports, inspections, afficial records, or other documentation. Sources exist pativitie the basis for information entered on the form and may be used to obtain further information about the site.
- Part 16. Past Response Activities
- *L Mindfledien: Refer to Part 1-1.
- H. Fast Remotes Astirities
 - 11-01 Past Response Activities: Check the appropriate best(es) to indicate response activities initiated prior to the passage of CERCLA, December, 1980.
 - H-82 Siste: Enter the start date (or approximate date) of the activity.
 - II-09 Agency: Enter the name of the Agency responsible for the activity.
 - 11-04 Description: Provide a brief nerretive description of the activity.
- 1H. Sources of Information: List the sources used to obtain information for this form. Sources cited may include: sample analysis, reports, inspections, official records, or other documentation. Sources cited provide the basis for information entered on the form and may be used to obtain further information about the site.

Part 11 Enforcement Jackstmation

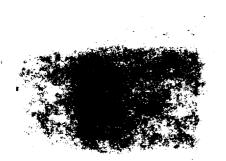
*I. Improvidence C. The Co. To-Li

II. Enforcement

II-01 Past Regulator and Inforcement Action: Check the appropriate body is indicate past regulatory or enforcement action at the federal, state, or local level related to this site.

II-02 Description of Federal, State, Local Regulatory or Enforcement Action: Provide a narrative description of regulatory or enforcement action to date. Do not include any enforcement action contemplated in the process of development.

III. Sources of Information: List the sources used to obtain information for this form. Sources cited may include: sample analysis, reports, inspections, official records, or other documentation. Sources cited provide the basis for information entered on the form and may be used to obtain further information about the site.



APPENDIX

F 19 78 3

36. 628-63-7

38. 7647-18-8

38. 7788-61-9

40. 10025-01-0

41. 7783-56-4

42. 1308-84-4

43. 1303-32-8

44. 1303-28-2

46, 7784-34-1

46. 1327-63-3

37. 62-63-3

Arrayl Accepts

Antimony Pentachieride

Antimony Tribromide

Antimony Trishloride

Antimony Trifluorids

Antimony Trioxide

Arsenic Disulfide

Arsenic Pentoxide

Arsenic Trichloride

Arsenic Trioxide

Aniline

2 4 2 2

I. FEEDSTOCK		\$			
CAS Number	California Planna	CAS Number	Chemical Name	CAS Number	Chamical Name
1. 7664-41-7	Americalis	14. 1317-38-0	Cupric Oxide	27, 7778-60-8	Potesium Dichromate
2. 7440-36-0	Antimony	16. 7788-86-7	Cupric Sulface	28, 1310-88-3	Potesium Hydroxide
3, 1309-64-4	Antimony Triexide	16. 1317-38-1	Cupreus Oxide	29. 115-07-1	Propylene
4. 7440-38-2	Arsonic	17. 74 -85- 1	Ethylene	30. 10588-01-6	Sedium Dichromete
5, 1327-63-3	Arsenic Trioxide	18. 7647-01-0	Hydrochlorie Acid	31, 1310-73-2	Sedium Hydroxide
6, 21109-95-5	Berium Sulfide	19. 7064-38-3	Hydrogen Fluoride	32, 7646-76-8	Stannic Chlorida
7, 7728-06-6	Bramine	20. 1336-25-7	Load Oxide	33, 7772-66-8	Stannous Chloride
8, 106-86-0	Butadiene	21. 7438-87-8	Mercury	34. 7004-03-0	Sulfuric Acid
9, 7440-43-8	Cadmium	22. 74-82-8	Methene	36. 108-86-3	Toluene
10. 7782-50-5	Chlorine	23. 91-26-3	Nepthelene	36, 1330-20-7	Xylene
11. 12737-27-8	Chromite	24. 7440-02-0	Nickel	37. 7846-85-7	Zine Chloride
12. 7440-47-3	Chromium	25. 7007-37-2	Nitris Asid	38, 7733-02-0	Zine Sulfate
13. 7440-48-4	Cobalt	26. 7723-14-0	Phosphorus	l	

II. HAZARDO	US SUBSTANCES				
CAS Number	Chemissi Name	GAS Number	Chemical Name	GAS Number	Chamical Name
1, 75-07-0	Acetaldehyde	47, 1308-33-0	Areanic Triguifide	92, 143-71-2	Courts Acetada
2. 64-19-7	Acetic Acid	46, 542-63-1	Berlum Cyenide	93. 12002-03-0	Cuarte Aceta senite
3, 108-24-7	Acetic Anhydride	40.71-43-2	Bensene	84. 7447-38-4	Cuerte Chloride
4. 7 5-86-5	Acetone Cyanahydrin	90. 65-85- 0	Bennois Acid	96, 3351-23-6	Cupric Nivers
5. 50 6-86- 7	Acetyl Bromids	\$1. 109-47-0	Consonitrite	96. 9993-46-3	Custite Chaletin
6, 75-36-6	Acetyl Chloride	52. 98-86-4	Benseyi Chieride	97, 7798-80-7	Cuarte Sulfate
7. 107-02-8	Acrolain	53. 100-44-7	Bensyl Chloride	99, 10090-29-7	Cusric Sulfate Ammonisted
8, 107-13-1	Acrylonitrile	54, 7440-41-7	Sarylllum	80. 815-82-7	Cupric Tertrate
9, 124-04-8	Adipic Acid	95. 7787-47-6	Beryllium Chloride	100.008-77-4	Cyanegen Chioride
10. 308-00-2	Aldrin	56. 7787-46-7	Beryllium Fluorida	101.110-63-7	Cyclohexane
11, 10043-01-3	Aluminum Sulfate	57. 13887-88-4	Boryllium Nitrote	103, 94-78-7	2.4-D Acid
12. 107-18-6	Allyl Alcehol	58 . 123-66-4	Butyl Asstate	100, 94-11-1	2.4-D Esters
13, 107-06-1	Aliyi Chioride	99. 84-74-2	n-Butyl Phthelete	104, 80-20-3	DOT
14, 7884-41-7	Ammonia	60. 108-73-0	Busylamine	105, 333-41-5	Distinge
15, 631-61-6	Ammonium Acetes	61. 107-62-6	Butyria Acid	106, 1916-00-0	Dicamba
16, 1863-63-4	Ammonium Benzoste	62. 543-66-6	Codimium Acetate	107, 1104-45-4	Dishishanii
17, 1066-33-7	Ammenium Biserbonese	69. 7768-42-6	Codmium Bremide	100, 117-00-6	Dishiene
18, 7789-08-6	Ammenium Bishremete	64. 10108-64-2	Codmium Chlorids	160, 26321-29-6	Dishlerobenzene (all isomers)
19, 1341-48-7	Ammenium Siffueride	66. 7778-44-1	Calelum Arsenate	110. 200-30-19-7	Dishlerepropene (all isomers)
20. 10192-30-0	Ammonium Sloutfles	88. 82746-16-6	Calelum Arsonite	111.20002-23-0	Dishloresropene (all isomers)
21. 1111-78-0	Ammonium Carbamete	, 67, 76-36-7	Calelum Carbida	112, 8000-19-6	Dighterepropens-
22. 12128-02-0	Ammoolum Chiertan	68. 13705-19-0	Calaium Chramath		Dishipropropene Mixture
23. 7788-88-8	American	60. 903-01-6	Calcium Cyanida	112,75-00-0	2-2-Dishloropropionic Acid
24. 3012-65-6	American	78. 20304-00-2	Calcium Dadacythencone	114.62-73-7	Dishloryes
25. 13826-83-0	America		Suffenete	115. 60-57-1	Diektrin
26. 12125-01-8	Amme	71, 7778-54-3	Calcium Hypochlarita	110,100-00-7	Diethylemine
27. 1336-21-6	Amm	72, 133-08-2	Canton	117, 124-40-3	Dissethylamine
28. 8008-70-7	Amm	72. 63-25-2	Carbanyl	118, 25154-54-6	Digitrobenzane (all isomers)
29. 10019-19-0	American	74. 1543-46-2	Carbofuran	119, 51-28-5	Dinitrophenol
30. 7773-08-0	Ammenta Bulliana	76, 78-15-0	Carbon Disulfide	120, 25221-14-0	Dinitrotaluene (all isomers)
31, 12135-76-1	Ammonium Suffide	76, 86-23-6	Carbon Tetraphierida	121.88-09-7	Digust
32. 10196-04-0	Ammonium Sulfite	77. 87-74-0	Chierdane	122, 200-04-4	Diguifeton
33. 14307-43-8	Ammonium Tertrete	78, 7782-80-6	Chierine	123, 339-64-1	Diuran
34, 1762-66-4	Ammonium Thiogyangs	78, 108-60-7	Chlerobenzene	124, 27170-67-0	Dedecylbenzenesulfonic Acid
36, 7783-18-8	Ammonium Thiosultate	89, 67-66-3	Chlereform	126, 116-20-7	Endacyton (all japmers)
36, 628,62.7	Acres Access			****	

Chlorosulfonic Acid

Chlorpyrifes

Chromic Acet

Chromie Acid

Cournephos

Crotonaldehyde

Creest

Chromic Sulfets

Chromous Chlorida

Cobeltous Formete

Cobaltous Sulfamete

81.7790-84-6

82, 2821-88-2

83, 1086-30-4

84. 7738-84-5

85. 10101-53-8

86. 10049-06-5

86. 14017-41-5

87.544-18-3

80.56-72-4

90. 1319-77-3

91.4170-30-3

126, 72-20-6

127, 106-00-6

128, 965-12-2

129, 100-41-4

130, 107-15-3

131, 106-63-4

132, 107-08-2

134, 1185-67-6

135, 2944-67-4

136, 7705-08-0

133. 60-00-4

Endrin and Metabolites

Epishlorohydrin

Ethyl Benzene

Ethylenediemine

Ferric Chloride

Ethylene Dibromide

Ethylene Dichloride

Ferric Ammonium Citrate

Ferric Ammonium Oxalate

Ethion

EDTA

HAZARD RANKING SYSTEM SCORING SUMMARY

FOR

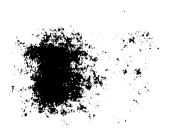
SIRCO SYSTEMS
EPA SITE NUMBER ALDO54563887
BIRMINGHAM
JEFFERSON COUNTY, AL
EPA REGION: 4

SCORE STATUS: IN PREPARATION

SCORED BY JOHN JENKINS OF NUS ON 06/16/88

DATE OF THIS REPORT: 09/02/88
DATE OF LAST MODIFICATION: 09/02/88

GROUND WATER ROUTE SCORE: 16.12
SURFACE WATER ROUTE SCORE: 6.15
AIR ROUTE SCORE: 0.00
MIGRATION SCORE: 9.97



HRS GROUND WATER ROUTE SCORE

	CATEGORY/F ACTO R	RAW DATA	ASN. VALUE	SCORE
1.	OBSERVED RELEASE	NO	0	0
2.	ROUTE CHARACTERISTICS			
	DEPTH TO WATER TABLE DEPTH TO BOTTOM OF WASTE	20 FEET 1 FEET		
	DEPTH TO AQUIFER OF CONCE	ERN 19 FEET	3	6
	PRECIPITATION EVAPORATION	52.0 INCHES	=	
	NET PRECIPITATION	10.0 INCHÉS	3 2	. 2
	PERMEABILITY	1.0X10-2 CM/SEC	з з	, s 3
	PHYSICAL STATE		3	3
	TOTAL ROUTE CHARACTERISTI	CS SCORE:		14
з.	CONTAINMENT		3	3
4.	WASTE CHARACTERISTICS			
	TOXICITY/PERSISTENCE: ASSI	GNED VALUE,18		18
	WASTE QUANTITY CUBIC YDS DRUMS GALLONS TONS	570 0 0		
	TOTAL	142 CU. YI	98 4	4
	TOTAL WASTE CHARACTERISTI	CS SCORE:		22
5.	TARGETS			
	GROUND 'N	•	8	6
	DISTANCE AND PEST WELL	14000 FEET MATRIX VALUE	4	4
	TOTAL POPULATION SERVED NUMBER OF HOUSES NUMBER OF PERSONS NUMBER OF CONNECTIONS NUMBER OF IRRIGATED AC	4 PERSON 1, 0 0 0	18	
-	TOTAL TARGETS SCORE:			10

HRS SURFACE WATER ROUTE SCORE

	CATEGORY	RAW DATA	ASN. VALUE	SCORE
1.	OBSERVED ROLEASE	NO NO	0	
	ROUTE CHARACTERISTICS		· · · · · · · · · · · · · · · · · · ·	
C .				
	SITE LOCATED IN SURFACE WATER SITE WITHIN CLOSED BASIN	NO NO		
	FACILITY SLOPE	1.0 %	_	
	INTERVENING SLOPE	1.0 %	0	0
	24-HOUR RAINFALL	3.5 INCHES	3	3
	DISTANCE TO DOWN-SLOPE WATER	1580 FEET	a	. 4
	PHYSICAL STATE	3		3
	TOTAL ROUTE CHARACTERISTICS SC	ORE:	1	10
з.	CONTAINMENT	3	······································	3
4.	WASTE CHARACTERISTICS	<u></u>		
	TOXICITY/PERSISTENCE: ASSIGNED	VALUE,18		18
	WASTE QUANTITY CUBIC YDS	0		
	DRUMB	570		
	GALLONS	0		
	TONS	. 0		
	TOTAL	148 CU. YD	8 4	4
	TOTAL WASTE CHARACTERISTICS SC	ORE 1		(SS
5.	TARGETS			
	SURFACE WATER USE	,	2	6
		- 1 47	•	^
	DISTANDE ENVIRONM	NONE	0	0
	FRESHALL	NONE		
	CRITIC	NONE		
	DISTANCE TO STATE WATER	> 3 MILES		
	DISTANCE TO WATER SUPPLY INTAK			
		MATRIX VALUE	0	Q
	TOTAL POPULATION SERVED	0		
	NUMBER OF HOUSES	0 - 5		
	NUMBER OF PERSONS	0		
	NUMBER OF CONNECTIONS NUMBER OF IRRIGATED ACRES	o 0		
	TOTAL TARGETS SCORE:			6

MATRIX VALUE

HRS AIR ROUTE SCORE

CATEGORY	RAW DATA	ASN. VALUE	SCORE
1. OBSERVED RELEASE	NO	•	0

2. WASTE CHARACTERISTICS

REACTIVITY:

INCOMPATIBILITY

TOXICITY

WASTE QUANTITY CUBIC YARDS

DRUMS BALLONS TONS

TOTAL

TOTAL WASTE CHARACTERISTICS SCORE:

3. TARGETS

POPULATION WITHIN 4-MILE RADIUS

- 0 to 0.25 mile
- 0 to 0.50 mile
- 0 to 1.0 mile
- O to 4.0 miles

DISTANCE TO SENSITIVE ENVIRONMENTS

COASTAL WETLANDS
FRESH-WATER WETLANDS

CRITICAL HABITAT

DISTANCE TO LAND USES

COMMERCIAL/INDUSTRIAL

PARK/FOREST/RESIDENTIAL

AGRICUL

PREM

HIST

IN AIEM.

TOTAL T

N/A

AIR ROUTE SCORE (Sa) = 0.00

HAZARD RANKING SYSTEM SCORING CALCULATIONS FOR

SITE: SIRCO SYSTEMS AS OF 09/02/88

GROUND ROUTE SCORE

ROUTE CHARACTERISTICS 14
CONTAINMENT X 3
WASTE CHARACTERISTICS X 22
TARGETS X 10

= 9240 /57,330 X 100 = 16.12 = S_{qw}

SURFACE WATER ROUTE SCORE

ROUTE CHARACTERISTICS 10
CONTAINMENT X 3
WASTE CHARACTERISTICS X 22
TARGETS X 6

= 3960 /64,350 X 100 = 6.15 = \$=

AIR ROUTE SCORE

OBSERVED RELEASE 0 /35,100

0 /35,100 X 100 = 0.00 =

SUMMARY OF MIGRATION SCORE CALCULATIONS

	8	S =
GROUND WATER ROUTE SCORE (S)	14.12	259.85
SURFACE SCORE (S)	4.15	37.82
AIR N	0.00	0.00
ST	• · •	297.67
		17.25
$S_{m} = \sqrt{(S^{m}_{mw} + S^{m}_{mw} + S^{m}_{mhr})/1.73}$		9.97

RECONNAISSANCE CHECKLIST FOR HRS2 CONCERNS

Instructions: Obtain as much "up front" information as possible prior to conducting fieldwork. Complete the form in as much detail as you can, providing attachments as necessary. Cite the source for all information obtained.

Site name: Sicco Systems

City, County, State: Birmingham, Jefferson Co., Alabama

EPA ID NO .: ALT 054563887

Person responsible for form: John Jenkins

Date: 6-16-58

Air Pathway

Describe any potential air emission sources onsite: No N ?

Identify any sensitive environments within 4 miles: Non 9

Identify the maximally exposed individual (nearest residence or regularly occupied building workers do count): $i \cos i k e i s = \cos k e$

Groundwater Pathway

Identify any areas of karst terrain: None Metech

Identify additional population due to consideration of wells completed in overlying aquifers to the AOC: NoNo

Do significant targets exist between 3 and 4 miles from the site? $\,N\,\omega$

Is the AOC a sole source aquifer according to Safe Drinking Water Act? (i.e. is the site located in Dade, Broward, Volusia, Putnam, or Flager County, Florida) N.A.

Souther water use only

Surface Water Pathway

Are there intakes located on the extended 15-mile migration pathway? No

Are there recreational areas, sensitive environments, or human food chain targets (fisheries) along the extended pathway?

Onsite Exposure Pathway

Is there waste or contaminated soil onsite at 2 feet below land surface or higher? There is no knowledge of any contaminated area onsite

Is the site accessible to non-employees (workers do not count)? No

Are there residences, schools, or daycare centers onsite or in close proximity? $N \circ$

Are there barriers to travel (e.g., a river) within one mile? N_{\odot}

Reference No. 1

United States Environmental Protection Agency Washington DC 20460

is

810609

This initial notification information is required by Section 103(c) of the Comprehensive Environmental Response, Compen- paper, Indicate the letter of the item sation, and Liability Act of 1980 and must which applies. be mailed by June 9, 1981.

eriesse type or print in ink. If you need additional space, use separate sheets of

A

B Site Location: Enter the common name (if known) and actual location of the site. ALD 0545 (3887) CivBirmingham CountyJefferson State AL 2 Person to Contact: Enter the name, title (if applicable), and business telephone number of the person to contact regarding information submitted on this form. Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Phone 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Phone 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env. Engin 804/281-2918 Name (Last. First and Title) Bent, Charles, Staff Env.	Zip Code 23261 Zip Code 35204 ineer							
Enter the name and acress or tree person or organization required to notify. Site Location:	Zip Code 35204							
B Site Location: Enter the common name (if known) and actual location of the site. ALDOS45 G388 CiviBirmingham CountryIefferson Steel AL 2 C Person to Contact: Enter the name, title (if applicable), and business telephone number of the person to contact regarding information submitted on this form. Name (Lest, First and Title) Bent, Charles, Staff Env. Engin Bent (Lest, First and Title) Bent,	Zip Code 35204							
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1. Organics 1. Mining	3001 of RCRA. Enter the ixes provided. A copy of can be obtained by							
2. Inorganics 2. Construction								
3. Solvents 3. Textiles								
4. Pesticides 4. Fertilizer								
5. Heavy metals 5. Paper/Printing								
6. Acids 6. Leather Tanning								
7. Bases 7. Iron/Steel Foundry	-							
8. PCBs 8. Chemical, General	' L							
40 S that are a second	RE O							
70. W official of the control of the								
12. ☐ Transformers 13. ☐ Utility Companies	i ≲							
14. C Senitery/Refuse	2							
15. Photofinish	• N							
15. Photofinish 16. Lab/Hospital	\$							
17. 🗆 Unknown								
18. Ø Other (Specify)								
manufacture of								
aluminum steel								

Form Approved OMB No. 2000-0138

containers

EPA Form 8900-1

	Notification of Hazardous Waste Site	Side Two	
F	Waste Quantity:	Facility Type Total Fac	cility Waste Amount
	Place an X in the appropriate boxes to indicate the facility types found at the site.	1. Piles cubic feet	Unknown
	In the "total facility waste amount" space	2. ☐ Land Treatment 3. ☐ Landfill gallons	
	give the estimated combined quantity	4. 🗆 Tanks Total Fac	ility Area
	(volume) of hazardous wastes at the site using cubic feet or gallons.	5. Impoundment	Unknown
	In the "total facility area" space, give the	6. Underground Injection	OHRHOWN
	estimated area size which the facilities occupy using square feet or acres.	7. Drums, Above Ground acres 8. Drums, Below Ground	
		9. 10 Other (Specify) <u>Unknown</u>	
G	Known, Suspected or Likely Releases	to the Environment:	
G	Place an X in the appropriate boxes to indicate or likely releases of wastes to the environments	ate any known, suspected,	Suspected Likely X None
		ig these items will assist EPA and State and local govering the items is not required, you are encouraged to do s	
H	Sketch Map of Site Location: (Option Sketch a map showing streets, highways, routes or other prominent landmarks near the site. Place an X on the map to indicate the site location. Draw an arrow showing the direction north. You may substitute a publishing map showing the site location.	al)	
ı	Description of Site: (Optional)		
	Describe the history and present conditions of the site. Give directions to the site and describe any nearby wells, springs, lakes, or housing. Include such information as how waste was disposed and where the waste came from. Provide any other information or comments which may help describe the site conditions.		
J	Signature and Title:		
	The person or authorized representative (such as plant managers, superintendents,	Name Lawrence C. Tropea, Jr.	Owner, Present
	trustees or attorneys) of persons required to notify must sign the form and provide a	Street 6601 W. Broad St.	Owner, Past Transporter
	mailing address (if different than address		☐ Transporter☐ Operator, Present
	in item A). For other persons providing notification, the signature is optional.	City Richmond State VA Zip Code 2	3261
	Check the boxes which best describe the relationship to the site of the person		☐ Other
	required to notify. If you are not required to notify check "Other".	Signature TUCA _ MEA Dete 81-0	0-03

POTENTIAL HAZA— Reference No. 2 PRELIMINAR EPS FORM 3012-II

1

TELEPHONE LOG SHEET

1.	Site Identification: Site number: ALDOS4563887
	Site name: SIRCO SYSTEMS INC.
2.	Interview Data: (Party called) Name: ED CAIN Position: Firm: SIRCO SYSTEMS INC Address: 2828 Sth. AVE NORTH
	BIRMINGHAM AL. 35204
	Telephone No.: 205-254-3533
3.	EPS Analyst Data: Name: Lill Lill Lill And PESI
	Name: WILL WARREN Purpose of call: TO DETERMINE OWNER AND HAZARDOUS
	WASTE ACTIVITY
	Form 2070-12 (7-81) P.N.
	Date of call: 8/1/84
4.	Interview Narrative Summary: MR. CAIN CONFIRMED THE PURCHASE
	BY JEMISON INVESTMENT CO. LAND COMPANY USES IS
	BY JEMISON INVESTMENT CO. LAND COMPANY USES IS LEASED FROM REYNOLDS ALUMINUM. LIBERTY NATIONAL INS.,
	VORFOLK SOUTHERN RAILWAY AND WALKER C. MADISON,
	EIRCO PRODUCES APPROXIMATELY 15 DRUMS PER
	YEAR OF WASH-UP SOLVENT WASTE FROM ROLL
	COAT DAINTING. ALLWORTH HAS TAKEN WASTE AND
	RECYCLED THE SOLUENT TO SIRCO. ALLWORTH HAS
	TOLD SIRCO THEY CAN NO LONGER TAKE THE
	WASTE WITHOUT AN EPA GENERATOR I.D. NUMBER.
	SIRCO IS IN THE PROCESS OF OBTAINING A
	CENERATOR NUMBER. TO THE REST OF MR. CAIN'S KNOWLEDGE
	THERE HAS BEEN NO ON-SITE DUMPING ACTIVITY
	THERE HAS DEEN NO UN OFFICE DUMPING FICTION
<u> </u>	
5.	Disposition/Comments: NO - PURTHER - ACTION.
б.	Comments: Any additional sites used by this company?
	Location: Dates of use:
	Description of waste:
	Comments:

POTENTIAL HAZARDOUS WASTE SITE_ PRELIMINARY ASSESSMENT EPS FORM 3012-111

INDUSTRIAL NARRATIVE SHEET

1. Site Identification:

Site number: ALB054563887

Site name: Sirco Systems, Inc.

Site county: Jefferson County

Industrial Narrative Summary:

Company Name: Sirco Systems, Inc.

Address: 2828 5th Avenue North

Birmingham, AL 35204

Telephone No.: 205-254-3533

Contact: Ed Cain

Discussion: Sirco Systems, Inc. manufactures steel drum components. Jemison Investment Company purchased Sirco from Reynolds Metals in 1979. Land is leased from Reynolds Metals, Liberty National Insurance, Norfolk, Southern Railway, and Walker C. Madison.

Sirco produces approximately fifteen drums per year of wash-up solvent waste from roll coat painting. Sirco has recycled the solvent waste with Allworth, but Allworth has told Sirco they could no longer take their waste without a generator EPA I.B. number. Sirco is in the process of obtaining a number.

To the best of their knowledge, there has been no on-site dumping activity.

3. Disposition:

No further action.

4. Comments:

State of Alabama



STATE HEALTH OFFICER

DEPARTMENT OF PUBLIC HEALTH

State Office Building Montgomery, Alabama 36130



1 1 011 10

June 2, 1981

MEMORANDUM

TO: Mr. Bernard E. Cox, Jr., Chief BSC

Hazardous & Industrial Waste Section

FROM: David Roberson, Environmentalist

Hazardous & Industrial Waste Section

RE: Waste Material, Sirco Systems, Inc., Birmingham, Alabama

On May 20, 1981, I met with the following representatives of the above named company:

Ms. Louise Faust - Purchasing Manager

Mr. Bill Patterson - Assistant Plant Manager

Mr. Gary Pender - Plant Foreman

This company had approximately 80-90, fifty-five gallon drums of a wax material to dispose of. The material is used in their process to coat metal for drums. The raw material is mixed with water and is recycled to a point where the mixture is approximately 75% water and the wax will no longer stick to metal. At this point, the waste is drained off into drums for disposal.

Since the local sanitary landfills do not accept liquids, I called the county sanitary engineering department upon my return to the office. I was advised, and I passed the information on to Ms. Faust by phone, to contact Mr. Bob Pogue, the pre-treatment engineer for the county, about disposing of this material by sewer.

I have not heard back from Ms. Faust at the time of this memo.

DLR:hj

	SECTION V - HEALTH HAZARD DATA
THRESHOLD LIMIT VALUE	NOT ESTABLISHED
EFFECTS OF OVEREXPOSURE	irritation Percental and and a
	irritation. Repeated or prolonged contact with ay cause skin irritation.
EMERGENCY AND FIRST AID PROEYES: Flush with cool	running water for 1) minutes and seek medical aid.
INGESTION: Call a phys	with soap and water. Cet medical check if necessary.
INHALATION: Remove to	fresh air and call a physician. Apply artificial respiration

							
STABILITY	STABLE			CONDITION	CONDITIONS TO AVOID		
			х				
INCOMPATABLE	ATV (Main	eriuls to avoi	<i>₹)</i>	strong	oxidizers, strong acids		
HAZARDOUS D	ECOMPOS	ITION PRO	DUCTS	none			
HAZARDOUS_		MAY OC	cua		CONDITIONS TO AVOID		
POLYMERIZAT	ION	WILL NO	TOCCUR	X			

SECTION VII - SPILL OR LEAK PROCEDURES
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED
Dilute with large volumes of water; neutralize with mild acid
and wash area with detergent and water.
VIASTE DISPOSAL METHOD
Dilute with large volumes of water; neutralize with mild acid and
dispose of in accordance with local, state and federal EPA regulations.

	SECTION VIII - SPECIAL P	ROTECTION INFORMATION
	TECTION (Specify type)	
FOR FIRE CONT	ITIONS: Use NIOSH/MESA appr	oved respirators.
VENTILATION	LOCAL EXHAUST	SPECIAL
	MECHANICAL (General)	OTHER
PROTECTIVE GLOV	ES RECOMMENDED	EYE PROTECTION WEAR SAFETY GLASSES
VITOSTORE NEHTO	F COLUMN TAIT	AND SAFETY SHOWER.

SECTION IX - SPECIAL PRECAUTIONS				
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING				
KEEP FROM FREEZING!				
OTHER PRECAUTIONS				
NONE				

PAGE (2)

GPO 934-150

430KFSCR Form OSHA-20 Rev. May 72

ALL INFORMATION IS ON PRODUCT AS SOLD viz. neat.

DAPARTMANT OF ENVIRG

Er. 24-42y A. White, ur. Chairmes

Thomas R. Ceditav u. Ernest Farner. 2.E. interim Co-Directors

James 1 Verr Interim Deputy Director Jesumber 10, 1962

Cor chilembers:
Thomas in Deut fontgomery
Or, Chile is, Ellis Illiminghem
is, Illiosi Ferrer A.E., Mobile
Statier' is Graves, Sylecouga
Or, Cameron McDonald, Birminghem
Russell L. Riley, Auburn

Meiling Address: State Capitol Hontgomery, AL 36130 Telephone: 205/277-3630

MEMCRANDUM

TO:

Har la Taylor

FROM:

Joe Brewer

RE:

Sirco Systems, Inc.

On November 9, 1982, I met with Mr. Mi Cain of Sirco Systems, Inc. and discussed the past hazardous waste activity. Mr. Cain stated that to his knowledge, no hazardous waste has ever been buried on the property that would require Superfund action... An inspection of the property aid not reveal any evidence of a past hazardous waste site.

Sirco Systems, Inc. makes stuel drum components. The waste generated at the facility in 1982, has been waste paper and scrap steel.

In 1981, the solvents generated at the facility were sold to All-Worth, Inc. of Birmingham, Alabama. Mr. Cain stated that no solvents have been generated at the plant in 1982.

JB:rc





CONSHOHOCKEN . PENNSYLVANIA 19428

April 30, 1981

Sirco Systems P.O. Box 637 Birmingham, AL. 35201

ATTN: Louise Faust

Purchasing Manager

Dear Ms. Faust:

We are enclosing Material Safety Data Sheets for products of interest to you. I trust these will meet with your requirements. Should you have need of additional details, please do not hesitate to contact me.

Very truly yours,

Nathryn F. Strang Kathryn F. Strang

Coordinator-Regulatory Affairs

KFS:eg

ENC: MSDS for FERROCOTE 120.

CC: R. Duell

1/19/81-Mr Homelton works. They can't who down of at all 1 will send Dave Robinson of tale by be view my product

Reference No. 5

MATERIAL SAFETY DATA SHERT

Required under USDL Safety and Health Regulations for Ship Repairing PROPRIETARY Information Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

Outker Chemical Corporation

				Quaker		
SECTION I						
MANUFACTURER'S NAME QUAKER CHEMICAL CORPORATION (215) 828-4250			E NO.			
ADDRESS (Number, Street, City, State, and ZIP Code) CONSHOHOCKEN, PA 19428						
CHEMICAL NAME AND SYNONYMS				AND SYNONYMS		
CHEMICAL FAMILY			FORMULA POLYETHY			trolow.
			sulfonate, water		, ,,	croredi
SECTION	111 -	HAZAR	DOUS INGREDIENT	rs		
PAINTS, PRESERVATIVES, & SOLVENTS	*	TLV (Units)	ALLOYS AND MET	ALLIC COATINGS	*	TLV (Units)
PIGMENTS			BASE METAL			
CATALYST	-		ALLOYS			·
VEHICLE .			METALLIC COATINGS	· · · · · · · · · · · · · · · · · · ·		
SOLVENTS	 	· ·	PLUS COATING OR COR	E FLUX		
ADDITIVES			OTHERS			
OTHERS				······································		
						TLV (Units)
SEC	TIO	N III - P	HYSICAL DATA			
BOILING POINT (°F.)	\top	212°F.	SPECIFIC GRAVITY (H25	0*1)	To.	984
VAPOR PRESSURE (mm Hg.)	1		PERCENT, VOLATILE BY VOLUME (%)		-	
VAPOR DENSITY (AIR=1)			EVAFORATION RATE		-	
SOLUBILITY IN WATER disperses pH		pH		1	0.0	
APPEARANCE AND ODOR stable, light tan emulsion						
SECTION IV - FIRE AND EXPLOSION HAZARD DATA						
FLASH PO:NT (Mathod uses) N.A. boils		212°F			T	Ue!
EXTINGUISHING MEDIA CO2, foam,			 			
SPECIAL FIRE FIGHTING PROCEDURES						
Use NIOSH/MESA approved respirators.						
UNUSUAL FIRE AND EXPLOSION HAZARDS NONE						

DEPARTMENT OF ENVIRO

Ed. 34-ey A. White, er. Chermet

"homes R. Jed'sv u. Emest Farner. 2.E. Intenm Co-Directors

James 1 - Verr Interim Deputy Director

December 10, 1982

Cor Ct. Members:
Tiomas in, Deut Mittentgemery
Dr. Ciure al, Ellic Lirminghem
Limitest Ferre A.E., Mobile
Glanter in Graves, Sylecauga
Dr. Cameron McDonald, Birmingham
Russell L. Riley, Auburn

Mailing Address: State Capitol Montgomery, AL 36130 Terephone: 205/277-3630

MEMCRANDUM

TO:

Har la Taylor

FROM:

Joe Brewer

RE:

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In 1981, the solvents generated at the facility were sold to All-Worth, Inc. of Birmingham, Alabama. Mr. Caim stated that no solvents have been generated at the plant in 1982.

JB:rc



DEPARTMENT OF ENVIRONWENTAL MANAGEMENT

Mailing Address:

September 26, 1984

State Capitol Montgomery, AL 36130 205/834-1303

Mr. James R. Hoagland SIRCO Systems, Inc.

Field Offices:

Post Office Box 367

Birmingham, Alabama 35201

P. O. Box 953 Decatur, AL 35602 205/353-1713

Re: ALD 054 563 887

225 Oxmeor Circle Birmingham, Al. 35209

205/942-6168

Unit 806, Building 8 Dear Mr. Hoagland:

In response to your recent notification of hazardous waste activity, your facility has been issued the EPA I. D. Number referenced above.

Mobile, AL 36609 <u>4</u>205/043-7841

4358 Mildmost Drive This number must be used to identify your facility when arranging for transport or disposal of hazardous waste, or when reporting to the Alabama Department of Environmental Management (ADEM) on hazardous waste management activity at your facility.

> You are referred to Section 4-246 of the Alabama Hazardous Waste Management Regulations for more information regarding your responsibility as a notifier.

Please contact us at 205-834-1303, if you have any questions.

Sincerely,

Bernard E. Cox, Jr., Chief Industrial and Hazardous Waste Section Land Division

SEC/DH/sdm

cc: Mr. Mames Scarbrough USEE - Region IV

POTENTIAL HAZARDOUS WAS PRELIMINARY ASSESS EPS FORM 3012-II

TELEPHONE LOG SHEET

1.	Site Identification:
	Site number: ALDOSAS 63887
	Site name:SACO SYSTEMS INC.
2.	Interview Data: (Party called) Name: CHUCK- BENT Position: Firm: REVNOLOS METALS Address: 6601 W BROAD ST. RICHARDND, VA. 23261 Telephone No.: 864-281-2918
	Name: CHUCK BENT
	Position:
	Firm: REVAIOLOS METALS
	Address: 6601 W. BRAAD St.
	PICHALDNA I/A 272.61
	Telephone No :
	reseptions to the graph of the
3	FDC Analyst Data
٠.	Name: WILL WARREN
	Purpose of call: TO CONFIRM DATE.
	Putpose of Carr. 10 CONPIENT DATE
	Form 2070-12 (7-81) P.N.
	FORM 20/0-12 (/-dl) P.N.
	Date of call: - Th/84
_	40 0
4.	Interview Narrative Summary: ME. BENI SAID REYNOLDS
	Interview Narrative Summary: MR. BENT SAID REYNOLDS 50LD SIRCO APPROXIMATELY 5 YRS. ACO.
	THE SUPERFUND NOTIFICATION WIND A PROTECTIVE WATTFICATION, TO THE BEST OF HIS KNOWLEDGE HE KHEW OF NO ON-SITE DUMPING ACTIVITY.
•	MATIFICATION, TO THE BEST OF HIS KNOWLEDGE HE
	KATEN OF NO ON-SITE DUMPING ACTIVITY,
	terre de la companya de la companya La companya de la comp
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<u> </u>	en e
· - ·	
_	
5.	Disposition/Comments:
· _	
	• • • • • • • • • • • • • • • • • • • •
6.	Comments: Any additional sites used by this company?
	Location:
	Dates of use:
	Description of waste:
	Company
	Comments:

DEPARTMENT OF ENVIRONWENTAL MANAGEMENT

Mailing Address: State Capitol Montgomery, AL September 26, 1984

Montgomery, AL 36130 205/834-1303

Mr. James R. Hoagland

SIRCO Systems, Inc.

Post Office Box 367

Birmingham, Alabama 35201

P. O. Box 953 Decatur, AL 35602 205/353-1713

Field Offices:

Re: ALD 054 563 887

Unit 806, Building 8 225 Oxmoor Circle Dear Mr. Hoagland:

225 Oxmoor Circl Birmingham, Al. 35209 205/942-6168

In response to your recent notification of hazardous waste activity, your facility has been issued the EPA I. D. Number referenced above.

4358 Midmont Drive Mobile, AL 36609 ₄205/343-7841 This number must be used to identify your facility when arranging for transport or disposal of hazardous waste, or when reporting to the Alabama Department of Environmental Management (ADEM) on hazardous waste management activity at your facility.

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Please contact us at 205-834-1303, if you have any questions.

Sincerely,

Bernard E. Cox, Jr., Chief
Industrial and Hazardous Waste Section
Land Division

SEC/DH/sdm

cc: Mr. James Scarbrough USER Region IV

POTENTIAL HAZARDOUS WAS PRELIMINARY ASSESS: EPS FORM 3012-11

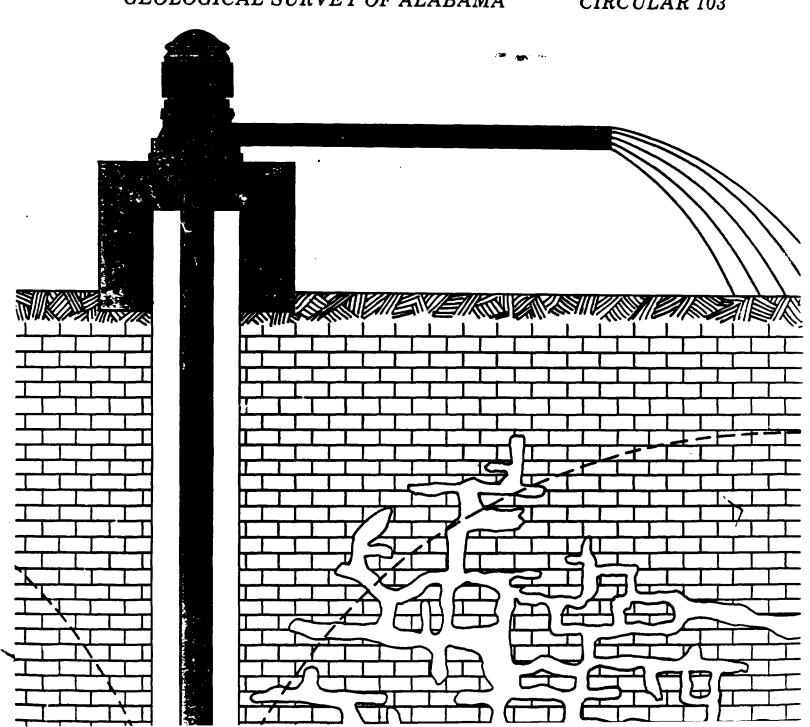
TELEPHONE LOG SHEET

1.	Site Identification: Site number: ALDOSAS 63887
	Site number: ALDOSAS 63881
	Site name:SARCO SYSTAMS INC.
	
2.	Interview Data: (Party called) Name: CHUCK- BENT Position: PONNOLS METALS
	Name: CHUCK- BENT
	Position:
	Fim: REYNOLDS NETALS
	Address: REYNOLDS METALS Address: 6601 W. BROAD ST. RICHMOND, VA., 23261
	RICHMOND, VA, Z3261
	Telephone No.: 804-281-2918
3.	Name: WILL WARREN
	Name: WILL WARREN
	Purpose of call: TO CONFIRM DATA
	Form 2070-12 (7-81) P.N.
	Form 2070-12 (7-81) P.N.
	Date of call: 7/4/84
4.	Interview Narrative Summary: MR. BENT SAID REYNOLDS
	SOLD SIRCO APPROXIMATELY 5 YRS. ACO.
	THE SUPERFUND NOTIFICATION WIND A PROTECTIVE
•	NATIFICATION, TO THE BEST OF HIS KNOWLEDGE HE
	KATEN OF NO ON-SITE DUMPING ACTIVITY,
-	
	· · · · · · · · · · · · · · · · · · ·
	en de la companya de La companya de la comp
<u> </u>	74.
	
c	Disposition/Comments:
٥.	
<u> </u>	
_	
6.	Comments: Any additional sites used by this company?
	Location:
	Dates of use:
	Description of waste:
	Comments:

GROUND-WATER RESOURCES OF THE BIRMINGHAM AND CAHABA VALLEYS, JEFFERSON COUNTY, ALABAMA

GEOLOGICAL SURVEY OF ALABAMA

CIRCULAR 103



GEOLOGICAL SURVEY OF ALABAMA

Thomas J. Joiner State Geologist

ENVIRONMENTAL DIVISION

Maurice F. Mettee
Chief

WATER RESOURCES DIVISION

Henry C. Barksdale Chief

CIRCULAR 103

GROUND-WATER RESOURCES OF THE BIRMINGHAM AND CAHABA VALLEYS OF JEFFERSON COUNTY, ALABAMA

by

Tola B. Moffett and Paul H. Moser

Prepared in cooperation with the City of Birmingham and Jefferson County

STATE OF ALABAMA Honorabie George C. Wallace, Governor GEOLOGICAL SURVEY OF ALABAMA AND STATE OIL AND GAS BOARD

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T. W. Daniel, Jr., Chief Geologist Frank Evans, Geologist Willard E. Ward, H. Geologist Camilla Gardner, Scientific Aide

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WITH OTHER AGENCIES
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U.S. Corps of Engineers
U.S. Gostogical Survey
Tennesses Valley Authority
Environmental Protection Agency Nation Aeronautics and Space Administr

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^aJ. T. Allen, Hydrol. Tech.

J. I. Allen, rydrell. Tech.
J. R. Avrett, Hydrolegast
D. D. Batemen, Hydrol. Tech.
R. H. Bingham, Hydrolegast

L. R. Bohman, Hydrologist J. E. Bewie, Hydrologist B. G. Byrd, Hydrol. Tech.

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B. L. McCraw, Edisorial-Cli.
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R. S. McHenry, Hydrol. Tech.
C. O. Ming, Hydrolegist
E. G. Ming, Hydrolegist
E. G. Ming, Hydrol. Tech.
G. H. Nelson, Hydrol. Tech.
G. H. O. Learner, Mudmalarins

J. G. Newton, Hydrologist D. A. Olin, Hydrologist

M. R. Powell, Clerk-DMT A. J. Roberts, Adm. Off. J. C. Scott, Hydrologist F. C. Sedberry, Hydrol. Tuch.

S. B. Simpson, Secretary T. A. Simpson, Jr., Hydrol. Tech. G. D. Swindel, Hydrol. Tech.

J. W. Tucker, Hydrol. Tech. T. E. Whitback, Carte. Tech.

University, Alabama April 25, 1978

Honorable George C. Wallace Governor of Alabama Montgomery, Alabama

Dear Governor Wallace:

I have the honor to transmit herewith the report, "Ground-Water Resources of the Birmingham and Cahaba Valleys of Jefferson County, Alabama," by Tola B. Moffett and Paul H. Moser. It is published as Circular 103 of the Geological Survey of Alabama.

The increasing population and expanding industry of Jefferson County make it imperative that every significant source of water be evaluated and its use included in the long-range planning for the county. The report points out that there probably is a significant quantity of unused ground water available in these two valleys. It was not possible within the scope of the investigation to estimate the perennial yield (the maximum quantity available). However, the report provides a sound basis for future quantitative estimates.

The report points out the need for orderly development based upon sound planning and a knowledge of the perennial yield of the aquifers. Unwise and excessive development might result in major problems of subsidence, reduced streamflow, or, possibly, induced contamination of the supply.

Respectfully,

Thomas J. Joiner State Geologist

Oil and Gas Supervisor

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GROUND-WATER RESOURCES OF THE BIRMINGHAM AND CAHABA VALLEYS OF JEFFERSON COUNTY, ALABAMA

By Tola B. Moffett and Paul H. Moser

ABSTRACT

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This study was undertaken to determine the quality and relative abundance of ground water in the Birmingham and Cahaba Valleys of Jefferson County. Abundant rainfall and the structural geology of the areas enhance the possible presence of large ground-water resources. Domestic, municipal, and industrial wells and springs were inventoried to determine the current use and relative quantity of ground water available. Water samples were collected and analyzed chemically. Generally, this investigation has indicated the presence of a substantial supply of good-quality ground water available for domestic, industrial, and municipal use.

The study areas were the Birmingham and Cahaba Valleys in Jefferson County, Alabama. These areas lie within the Valley and Ridge province and are characterized by northeast-southwest trending valleys and ridges. Having an average annual rainfall of 53 inches, the Birmingham and Cahaba Valleys receive approximately 207 and 16.5 billion gallons of water, respectively, each year.

The areas of investigation are underlain by shales, sandstones, limestones, dolomites, cherts, and lesser amounts of unconsolidated deposits of clays, sands, and gravels. The exposed geologic units range in age from Cambrian to the present and, together, consist of over 10,000 feet of sediment. The structural geology of the areas is complex with a series of anticlines and synclines that have parallel thrust faults and high-angle cross faults. Many of the geologic formations dip sharply into the subsurface as a result of intense folding. A large amount of faulting associated with the folding of rocks has displaced and fractured the rocks in many areas. The porosity and permeability of the rocks is often greater in these fractured zones and, as a result, larger well yields arm possible.

The ground-water resources of the Birmingham and Cahaba Valleys are being used to a limited extent by homeowners, industry, and public water systems. A few springs are being used as public supplies, but most of the water from springs flows unused into storm drains and streams.

A well inventory indicated that ground water in the study areas is readily accessible by drilling. Depths reported for all wells inventoried range from 20 to 620 feet. Fighty percent of the wells are less than 300

feet deep. The median depth for all the wells is 160 feet. Eighty percent of the domestic wells have depths less than 200 feet.

Reported yields of domestic wells range from 2 gallons per minute (gpm) to 22 gpm; the median yield is 7 gpm. More than 70 percent have yields equal to or greater than 5 gpm. Reported yields of municipal and industrial wells in the study areas range from 50 gpm to 1,200 gpm.

Several aquifers within the two areas appear to have great potential as sources of ground water. The Fort Payne Chert-Tuscumbia Limestone aquifer is probably best suited for development because its geologic properties greatly increase the likelihood of obtaining a successful high-yielding well and it is confined in some areas by two formations which form barriers against contamination and subsidence. Artesian conditions occur in this aquifer over much of its extent in the study areas. This aquifer currently sustains large-production wells.

Sixty-four samples of ground water were collected for chemical analysis during the investigation. The results of the analyses indicate that the ground water in the study areas is chiefly of the calciumbicarbonate type and that, in general, no significant chemical contamination has occurred. Iron was the only chemical constituent whose concentration exceeded drinking-water standards, and this happened only in a few samples. Nitrate parameters, which may indicate organic contamination from feed lots cesspools, sewage, or the use of fertilizers, were higher than normal but did not exceed drinking-water standards.

In many situations, it is much more advantageous to use ground water than to depend on surface-water availability. Because wells can often be located near the consumer, transporting costs may be greatly reduced. As is seen in data from the Leeds Water Board, pumping costs are minimal. If artesian conditions are present, pumping costs may be further reduced. Because ground water has been filtered and purified naturally, treatment costs are also reduced.

Because of the quality and availability of ground water in the Birmingham and Cahaba Valleys, this valuable natural resource should be protected and well-managed. Orderly planning and careful development are necessary to prevent over-development, subsidence, reduced streamflow, and contamination. With proper management, the ground-water supplies of the Birmingham and Cahaba Valleys could be a valuable and continuing asset in the future development of Jefferson County.

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INTRODUCTION

Increased demands upon the natural resources of Alabama require plans to develop and conserve these resources with maximum benefit for the future. Water is such a resource, and its development requires a knowledge of its availability, distribution, quality, and potential use. These factors are necessary for economic planning and optimum use of the water resources.

PURPOSE AND SCOPE

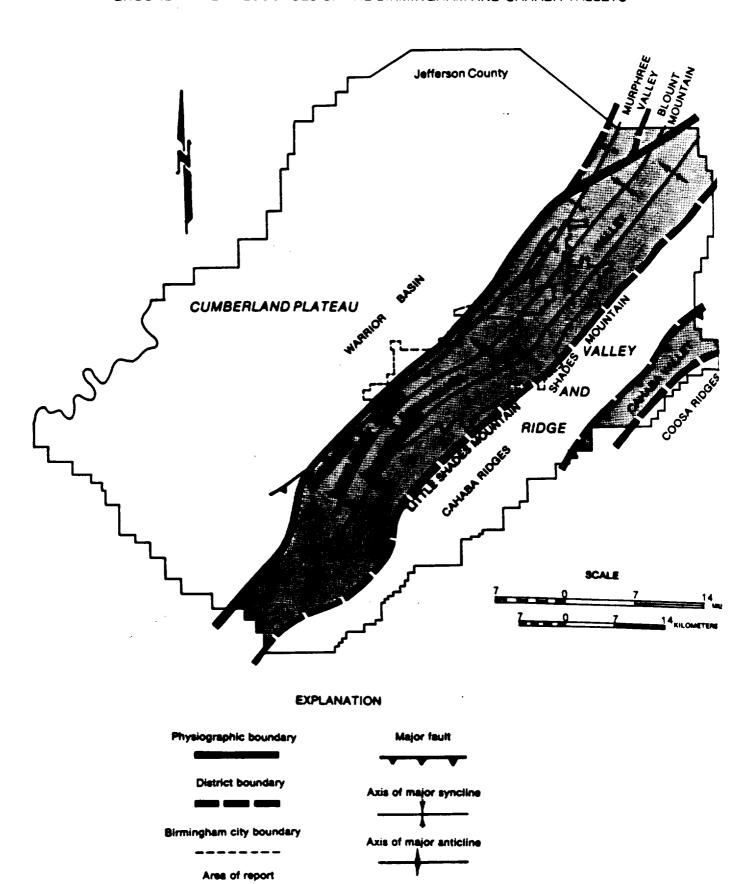
The purpose of this investigation was to determine the occurrence and use of ground water in the Birmingham and Cahaba Valleys of Jefferson County, Alabama. The aquifers in both valleys are predominantly carbonate rock and are peculiarly subject to contamination. They have the capacity to produce substantial quantities of water from properly located and constructed wells. The primary objectives of this study were to identify those aquifers having the greatest water-producing potential, to inventory the current uses of ground water, and to ascertain if there is any significant chemical contamination.

LOCATION AND PHYSIOGRAPHIC SETTING

The areas covered by this report include a major part of the southeastern half of Jefferson County (fig. 1). The areas are primarily within the Birmingham-Big Canoe Valley and Cahaba Valley physiographic sections of the Valley and Ridge provinces which are characterized by northeast-southwest-trending valleys and ridges. The Birmingham Valley is from 3 to 7 miles wide and extends from the Tuscaloosa County line northeastward to Gadsden where it opens into the Big Canoe Valley. Birmingham Valley is bounded on the northwest by an escarpment formed by the Pottsville Formation and the edge of Blount Mountain and on the southeast by Little Shades Mountain. Flint Ridge divides Birmingham Valley into two smaller valleys at the southern end of Blount Mountain. Opossum Valley lies to the west of Flint Ridge and Jones Valley to the east. Birmingham Valley contains approximately 225 square miles in Jefferson County.

The Cahaba Valley is bounded on the northwest by the Cahaba Ridges and on the southeast by the Coosa Ridges. The valley is about two miles wide at Leeds and includes an area of approximately 18 square miles in Lefferson County.

4 GROUND-WATER RESOURCES OF THE BIRMINGHAM AND CAHABA VALLEYS



CLIMATE

Climatic records for the Birmingham area have been collected by the U. S. Weather Bureau since 1896. The average annual rainfall is 53 inches, March and October having the highest and lowest average monthly precipitations, respectively.

Monthly temperatures for the period of record range from a January mean of 44°F to a July mean of 80°F. The average length of the growing season is 239 days. The topography of Birmingham can contribute to extreme temperature inversions and low minimum temperatures during the winter months (U. S. Dept. Commerce, 1975).

PREVIOUS INVESTIGATIONS

One of the earliest geologic investigations of the Birmingham area was that of Charles Butts (1910). Butts produced a folio that included information on the geology, topography, and structure of the area. He prepared a similar geologic folio of the Bessemer-Vandiver area in 1927. The most detailed geologic descriptions of Mississippian formations in the Birmingham area are included in a publication by Thomas (1972).

Johnston (1933) included a description of ground water in Jefferson County in his report on the Paleozoic rocks of northern Alabama. Robinson, Ivey, and Billingsly (1953) investigated the surface and ground-water resources of the Birmingham area and emphasized the development and usage of water resources. A more recent investigation by Simpson (1965) describes ground-water problems associated with iron-ore mining in the Birmingham area. Knight (1976) describes the general availability of ground-water and surface-water resources in Jefferson County.

METHODS OF INVESTIGATION

Information on well construction, depth, yield, use, and reliability was collected on approximately 200 domestic, municipal, and industrial wells and springs during this investigation. Information on springs was collected primarily from those having discharges greater than 50 gallons per minute (gpm). Records of well and spring data are



that do not tap the carbonate-rock or Hartselle Sandstone aquifers. They are reported for possible future reference but are not included in the analyses or summaries in this report. Plate 1 shows the locations of the wells and springs.

Data on wells and springs were collected primarily from January to March 1977. The large area involved and the variations in local population density precluded a general inventory of the entire area. Therefore, wells along representative geologic cross-sections, which consisted of two zones south and two zones north of metropolitan Birmingham, were inventoried. High-yielding wells were inventoried wherever they occurred. The scarcity of wells and springs in the metropolitan area necessitated the use of a diffuse inventory of that area. Furthermore, many wells and springs in the Leeds area were inventoried because of the small area involved. It is believed that the resulting inventory is an adequate and representative sample.

Water samples were collected from 38 wells and 26 springs and analyzed in the water-quality laboratory of the Geological Survey of Alabama. Temperature and specific conductance and, when possible, pH and alkalinity were determined at the time of sample collection.

Because water quality may be changed by storage, an attempt was made to pump domestic wells for 30 minutes prior to sample collection if the water was being passed through a pressure tank ahead of the sampling point. Water levels were recorded as these wells were being pumped and the data were used to estimate specific capacities of the wells. Results of the pumping data are included in table 1 and results of the water-quality analyses are given in table 2.

ACKNOWLEDGMENTS

The authors acknowledge the assistance of the many owners of domestic, municipal, and industrial wells and springs who provided information on their ground-water supply. Many of these persons were especially helpful by allowing use of their pumping equipment to collect water samples.

Mr. Paul Pate of the Jefferson County Health Department provided valuable information on water-supply systems and well locations in the area. Mr. Fred Scott of the Leeds Water Board provided helpful information on yields and the cost of pumping water for the Leeds area. Mr. Stan Graves of Graves Drilling Company in Sylacauga furnished information on locations, construction, and yields of several

information on the present costs of test-drilling programs, well construction, and water treatment necessary to successfully develop ground-water supplies.

GEOLOGY

The geologic units exposed in the areas of investigation range in age from Cambrian (600 million years ago) to Holocene. Together, the units represent an aggregate thickness of over 10,000 feet of sediment. The geologic characteristics of each unit are discussed briefly because these characteristics significantly affect the movement and occurrence of ground water within the two areas. These descriptions were taken from information provided by J. T. Kidd and S. W. Shannon of the Geological Survey of Alabama. More detailed descriptions of the geology of the area are presented in reports by Burchard and others (1910), Adams and others (1926), Butts (1927), Johnston (1933), and Thomas (1972).

STRATIGRAPHY

CAMBRIAN SYSTEM

ROME FORMATION

The Rome Formation, exposed only in the Cahaba Valley, is the oldest geologic unit exposed in the areas of investigation. This formation consists of about 500 feet of greenish-gray and purplish-red shale and rare thin beds of argillaceous limestone, chert, or sandstone.

CONASAUGA FORMATION

The Conasauga Formation occurs throughout the Birmingham and Opossum Valleys, but is absent in the Cahaba Valley. The Conasauga, estimated to be between 1,100 and 1,900 feet in thickness, consists of thin-bedded limestone, shale, and dolomite. Thin prismatic chert fragments commonly occur in the residuum.

KETONA DOLOMITE

The thick-bedded Ketona Dolomite consists of from 400 to 600 feet of relatively chert-free dolomite. The Ketona occurs throughout the Cahaba and Opossum Valleys and the Birmingham Valley north of

McCalla but is probably absent south of McCalla.

KNOX GROUP UNDIFFERENTIATED

The Knox Group, consisting of thick-bedded cherty dolomite and lesser amounts of limestone and dolomitic limestone, generally weathers to irregular boulders and fragments of light-gray to grayish-pink chert. Exposed throughout the Birmingham and Cahaba Valleys, the Knox Group is estimated to be approximately 2,000 feet thick in the Birmingham area.

ORDOVICIAN SYSTEM

ORDOVICIAN LIMESTONES UNDIFFERENTIATED

This unit does not occur in the Birmingham Valley. It is composed of about 1,000 feet of medium-bedded crystalline limestone that is fossiliferous and/or cherty in part. Some authors subdivide this interval on the basis of fossil content and lithologic changes; however, it represents a single hydrologic unit and, therefore, is not differentiated in this report.

CHICKAMAUGA LIMESTONE ATTALLA CHERT CONGLOMERATE MEMBER

The Attalla Chert Conglomerate Member occurs at the base of the Chickamauga Limestone and has an average thickness of 20 feet and a maximum thickness of 50 feet. The Attalla is a very coarse-grained chert and quartz sandstone and/or a coarse conglomerate. The conglomerate consists of a matrix of chert fragments containing rounded chert cobbles and boulders as much as 12 inches in diameter.

CHICKAMAUGA LIMESTONE

The Chickamauga Limestone consists of 200 to 500 feet of thin- to medium-bedded fossiliferous limestone. Some interbeds of argillaceous or crystalline limestone, shales and rare bentonite may also be present. The Chickamauga does not occur in the Cahaba Valley but is exposed in the Birmingham-Big Canoe Valley. The best exposures in Jefferson County are in the abandoned quarries on Red

GEOLOGY 9

SILURIAN SYSTEM

RED MOUNTAIN FORMATION

The Red Mountain Formation consists of 200 to 500 feet of siltstone, sandstone, shale, and hematite beds that range from 5 to 30 feet in thickness. Thin beds of limestone may also be present. The Red Mountain Formation is present throughout the Birmingham Valley, but it is absent in the Cahaba Valley.

DEVONIAN SYSTEM

FROG MOUNTAIN SANDSTONE AND CHATTANOOGA SHALE

The Frog Mountain Sandstone, consisting of 4 to 27 feet of medium- to thick-bedded hematitic sandstone and conglomerate, occurs intermittently throughout the Birmingham and Cahaba Valleys.

The Chattanooga Shale consists of as much as 20 feet of brownish-black shale that contains occasional thin sandstone interbeds. The formation is generally absent in the northern and western parts of the Birmingham Valley and occurs sporadically along the eastern side of the Birmingham Valley.

MISSISSIPPIAN SYSTEM

MAURY FORMATION, FORT PAYNE CHERT, AND TUSCUMBIA LIMESTONE

The Maury Formation consists of 1 to 3 feet of greenish-gray to grayish-red thinly laminated shale that commonly contains phosphate nodules. The Maury occurs intermittently throughout the Birmingham area and, due to its limited thickness, is mapped with the overlying Fort Payne Chert and Tuscumbia Limestone.

The Fort Payne Chert is usually highly weathered in most exposures and consists of 90 to 200 feet of bedded fossiliferous chert. In the northern part of the county, unweathered Fort Payne consists of dark-gray limestone and dense dark-gray chert. The chert beds are distinct and range from a few inches to 2 feet in thickness. Irregular to smooth bedding surfaces are often separated by thin shaly zones.

The Tuscumbia Limestone consists of thick-bedded limestone units and lesser amounts of chert. The Tuscumbia does not occur in

the Cahaba Valley and is rarely exposed in the Birmingham area. The maximum thickness of the Tuscumbia in Jefferson County is not known; however, the formation is reported by Adams and others (1926) to be approximately 80 feet thick in the area north of Trussville and is 80 feet thick near the Greenwood subdivision southwest of Bessemer.

PRIDE MOUNTAIN FORMATION

Normally, the Pride Mountain Formation has a basal bed of limestone that may be as much as 8 feet thick; however, this bed is absent at some localities. Overlying the basal limestone are 100 to 350 feet of dark-gray shale and locally occurring thin beds of siltstone or fine-grained sandstone. The formation is generally poorly exposed, although good exposures can be seen at Vann's Quarry north of Trussville. The Pride Mountain is indistinguishable from the Floyd Shale in many places, and it is mapped with the Floyd Shale where the overlying Hartselle Sandstone is absent.

HARTSELLE SANDSTONE

The Hartselle Sandstone is composed mainly of very fine- to medium-grained sandstone that ranges from a feather edge to 120 feet in thickness and weathers to a sandy soil. In the Birmingham Valley, the formation occurs mostly as a medium- to thick-bedded orthoquartzite; it occurs in the Cahaba Valley as a thin- to medium-bedded sandstone. The Hartselle thins and pinches out southwestward in both valleys before reaching the Jefferson County boundary.

BANGOR LIMESTONE

The Bangor Limestone consists of medium-bedded limestone, but beds of clayey limestone or shale may occur intermittently. The formation ranges in thickness from a feather edge in the southwest part of the Birmingham Valley to about 500 feet in the subsurface of the northeast part of Jefferson County. Outcrops rarely exceed 150 feet in thickness as the formation readily weathers to a dark-brown soil. The best exposures in the county are in the abandoned quarries 1 mile southwest of Trussville and along the railroad at the northeast end of Norris Railroad Yards in Irondale. The Bangor is not exposed in the Cababa Valley in Jefferson County

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FLOYD SHALE

The Floyd Shale consists of 500 to 600 feet of dark-gray clayey shale and locally occurring thin siltstone beds. Outcrops are scarce as the Floyd readily weathers to a brown or light-gray massive clay. Two miles west of Greenwood and at Leeds, the Floyd Shale has been extensively mined for use in the ceramics industry.

MISSISSIPPIAN AND PENNSYLVANIAN SYSTEMS

PARKWOOD FORMATION

The Parkwood Formation, a part of which is in the Pennsylvanian System, is composed of interbedded sandstone and gray shale. Generally, sandstone is more abundant in the southeast part of the county. The sandstone is very fine- to fine-grained and occurs as beds that range from less than 1 inch to as much as 6 feet in thickness. The shale beds may be thin or massive. The formation is about 1,400 feet thick in the Trussville area but thickens to the southwest to about 2,500 feet in the area south of Greenwood.

PENNSYLVANIAN SYSTEM

POTTSVILLE FORMATION

The Pottsville Formation consists of alternating beds of sandstone and shale and numerous coal seams and associated beds of "underclay." Sandstone near the base of the formation consists predominantly of quartz and is replaced locally by beds of quartzpebble conglomerate. Sandstone in the upper part of the formation is composed of quartz and metamorphic rock fragments. This upper part of the Pottsville contains most of the economically important coal seams. The Pottsville is about 2,000 feet thick in west Jefferson County and has an undetermined thickness in east Jefferson County where it is highly faulted and folded.

UPPER CRETACEOUS SYSTEM

TUSCALOOSA GROUP

COKER FORMATION

The Coker Formation consists of unconsolidated beds of sand, clay, and gravel. The sand is usually fine to coarse grained and quartzose and, in most exposures, has been stained by iron compounds to various shades of orange. Chert gravel generally occurs near the base of the formation. Secondary deposits of goethite-limonite occur in the Coker Formation and may be present in economic concentrations. The Coker occurs as isolated outliers in the southern part of the county where it reaches a maximum thickness of 60 feet.

QUATERNARY SYSTEM

QUATERNARY? GRAVELS

Unconsolidated to semi-consolidated sand and gravel deposits of probably Quaternary age occur at several places in the Cahaba Valley and at one place north of Trussville in the Birmingham Valley. The deposits consist of quartzite pebbles and cobbles and some chert cobbles in a matrix of chert fragments and/or fine- to very coarse-grained quartz and chert sand. One deposit, about 50 feet thick, is exposed along Interstate Highway 20 where it crosses Pine Ridge at Leeds.

ALLUVIUM AND LOW TERRACE DEPOSITS

Along and immediately adjacent to the larger streams in the county are relatively recent unconsolidated deposits of gravel, sand, and silt. Sediments in these deposits have been eroded from the underlying bedrock and transported and deposited by the streams along which they occur. Chert and quartz fragments are the main components of the coarser sediments; fragments from many of the older rock units may also be identified. The thickness of these deposits rarely exceeds 30 feet.

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STRUCTURE

The structural geology of the areas of investigation is complex and distinctly affects the occurrence of ground water in some areas. The study areas contain a series of anticlines and synclines that have parallel thrust faults and high-angle cross faults (fig. 1). The Birmingham-Big Canoe Valley is developed upon a faulted asymmetrical anticlinorium that exposes limestones, dolomites, shales, sandstones, and cherts (Johnston, 1933). Many of the geologic formations dip steeply into the subsurface as a result of the intense folding. A large amount of faulting and jointing associated with the folding of the rocks has displaced and broken the rocks in many areas. This has resulted in increased solution and porosity of the rocks. The faults can adversely affect water-well development because the broken zones in and near the faults may produce large amounts of sediment. Careful selection of test drilling sites near fault zones is warranted.

HYDROLOGY

HYDROLOGIC CYCLE

Precipitation, surface runoff, evapotranspiration, and ground-water recharge and discharge are major components of the hydrologic cycle (fig. 2). Through this cycle, and as a result of natural processes, water can be continuously purified and used by plants and animals without depleting the supply. The oceans are the primary reservoir that supplies and receives the enormous quantities of water involved in the hydrologic cycle. The recycling of this water to and from the ocean results from forces exerted predominantly by the sun's energy and the earth's gravity. In general, the sun supplies energy to evaporate water from the ocean. This water rises as a vapor into the atmosphere where it forms clouds. Eventually, this moisture moves over the land, condenses, and falls back to the earth in some form of precipitation. Responding to gravity, this precipitation then begins a slow but constant movement through the surface- and ground-water systems back toward the ocean.

In Jefferson County, an average of 53 inches of precipitation, usually rain, falls on the land surface each year. This 53 inches of rain falling upon the 1,120 square miles in Jefferson County is equal to about 138 billion cubic feet or slightly more than 1 trillion gallons of water each year. Not all of this water is available for man's use because of the requirements of the other components of the hydrologic cycle. A

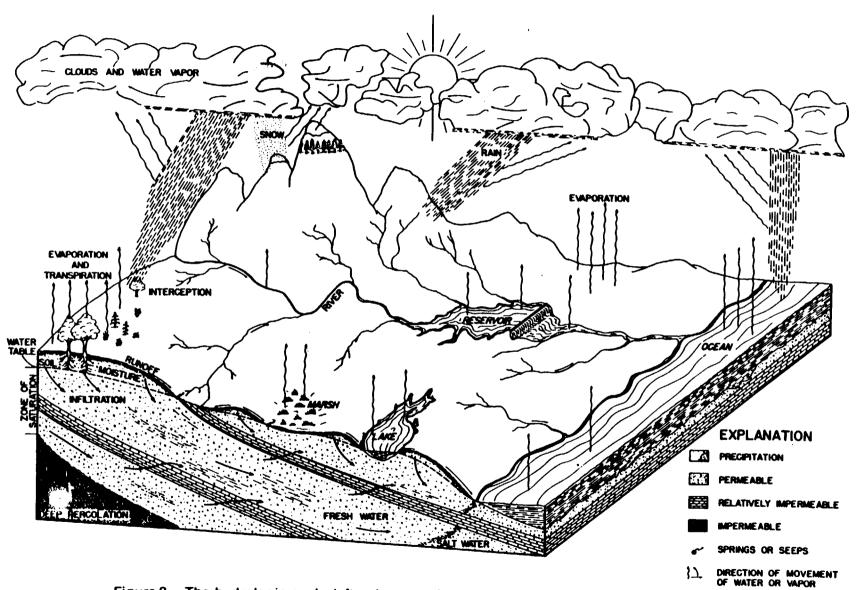


Figure 2.—The hydrologic cycle (after Jones and others, 1963).

SALT WATER

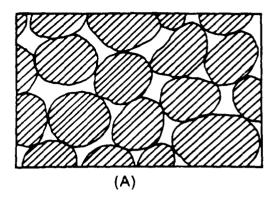
significant part of this water flows directly over the surface of the land to streams and toward the ocean. Some of the surface runoff is trapped behind dams for man's use. Evapotranspiration accounts for a significant percentage of the total precipitation. Water evaporates from stream and land surfaces and is transpired by plants. However, some is retained within the soil zone where it is available for use by plants in their life processes. That water which does not flow directly to streams or pass into the atmosphere by evapotranspiration moves downward through the soil and recharges or replenishes the groundwater reservoir. Ground-water recharge represents a substantial part of the annual precipitation. It is this part of the hydrologic cycle, ground water, with which this investigation is primarily concerned.

GROUND-WATER OCCURRENCE

Many people mistakenly believe that ground water occurs in underground rivers or streams; actually, ground water is contained within the rocks beneath each square foot of the earth's surface. Variations in the yields of individual wells are related to the ability of the rocks to transmit this water through interconnected openings or passageways, many of which are minute. These openings and passageways contribute to the porosity and permeability, respectively, of the rocks.

Porosity is a percentage value that reflects the volume of open spaces within a specified volume of rock. For example, beach sand has a porosity of about 35 percent. About 2.5 gallons of water could be contained in the open spaces between the grains in 1 cubic foot of beach sand. This water would fill the spaces between the grains but would not increase the volume occupied by the sand. An illustration of how water is contained within the pores or open spaces in the and is shown in figure 3A. The Hartselle Sandstone is a formation in the Birmingham and Cahaba Valleys that contains water within pore spaces between sand grains. This formation also contains water in fractures or cracks in the rock. Sandstones, which usually have porosities of 5 to 30 percent, are generally more porous than carbonate rocks, which usually have porosities of 1 to 15 percent or less.

Limestones and dolomites comprise the majority of the geologic formations within the Birmingham and Cahaba Valleys of Jefferson County. Unlike some sandstone units which may have regular zones of porosity, the porosity of carbonates can vary throughout the formation. The rock may have a high porosity at one point and only a



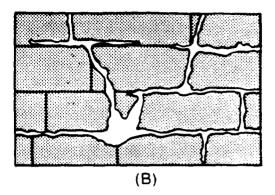
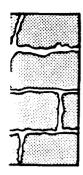


Figure 3.—Rock interstices and the relation of rock texture to porosity. (A) well-sorted sedimentary deposit (i.e., sand) having high porosity; (B) rock rendered porous by solution (i.e., limestone). Clear spaces'in diagrams indicate openings that may contain water (after Meinzer, 1923).

very limited porosity a few feet away. This sudden variation in porosity becomes obvious when wells drilled very close together yield drastically different quantities of water.

Hydrogeologists usually refer to the porosity of limestone and dolomite as secondary porosity. This designation is used because the original porosity, developed when the rocks were formed, has been altered. Rainfall infiltrating the soil zone collects carbon dioxide produced by organic decomposition within the soil. This carbon dioxide combines with the water to form very weak carbonic acid that reacts with the carbonate rocks and dissolves them. Solution is greatest along zones of weakness in the rock, such as bedding and fracture planes. Gradually, over centuries, this slow removal of the rock materials by solution from the carbonates creates spaces or pores within the rocks. The porosity of the limestones and dolomites in Jefferson County results primarily from solution. Figure 3B is an illustration of the general porosity characteristics of carbonate rocks.

Permeability refers to the ability of a porous material to transmit a fluid such as water. Permeability is usually related to the degree to which the pore spaces are interconnected. The permeability of many rocks is relatively uniform. However, this may not be true of the limestones and dolomites in the Birmingham and Cahaba Valleys. For example, at a particular site, a limestone could have a high porosity because of the presence of a large cavern. The permeability of the surrounding rock might below, however, and a well drilled within a few feet of the cavern might be a failure even though the cavern was completely filled with water.



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Hydrogeologists attempt to find areas of increased porosity and permeability because these areas are associated with productive ground-water supplies. The porosity of carbonate rocks frequently increases in valleys because of increased drainage of water that results in greater solution of the carbonate materials. In some areas, such as Jefferson County, geologic forces and stresses have produced fracture zones that have aided the solution process, thus, increasing the porosity and permeability of the fractured rocks.

Even though porous rocks may contain vast quantities of water, these reserves and resources may be neglected or misunderstood simply because they have infiltrated through the soil and can no longer be directly observed by man. The quantity of water contained within a ground-water reservoir can be very deceiving. For example, 1 square mile of limestone saturated to a depth of 300 feet and having an overall porosity of 2 percent would contain 1.25 billion gallons of ground water.

A water-saturated geologic zone that will transmit water to a well or spring is termed an "aquifer". In general, there are two types of aquifers. In one type, the water-table aquifer, the ground water is unconfined because the upper surface of the ground water is in contact with the atmosphere. This upper surface is similar to the surface of water in a tank except that the ground water is contained within the pores of rocks. The upper surface of the ground water is referred to as the water table, and it conforms roughly to the shape of the land surface. The water table will fluctuate up and down in response to recharge by infiltrating rainfall and to ground-water movement into or out of the aquifer.

In the other type of aquifer, an artesian aquifer, the ground water is confined between impermeable layers of rocks or sediment. The water is no longer in contact with the atmosphere and occurs at pressures greater than atmospheric pressure. In an artesian aquifer, this pressure is great enough to cause a column of water to rise above the top of the aquifer. The water may be forced into a well that has penetrated the aquifer, or it may flow upward through faults or solution cavities in the rock. The height of the water column is controlled by the pressure within the aquifer. The water may or may not rise to the land surface. The imaginary surface to which water would rise at any point overlying the aquifer is called the piezometric surface. Figure 4 is an illustration showing the general characteristics of a water-table aquifer and an artesian aquifer.

Figure 5 depicts the water-table in a hydrogeologic cross-section through Jones Valley south of Birmingham. The angles of dip of the geologic units are greatly exaggerated in the figure. Water-table

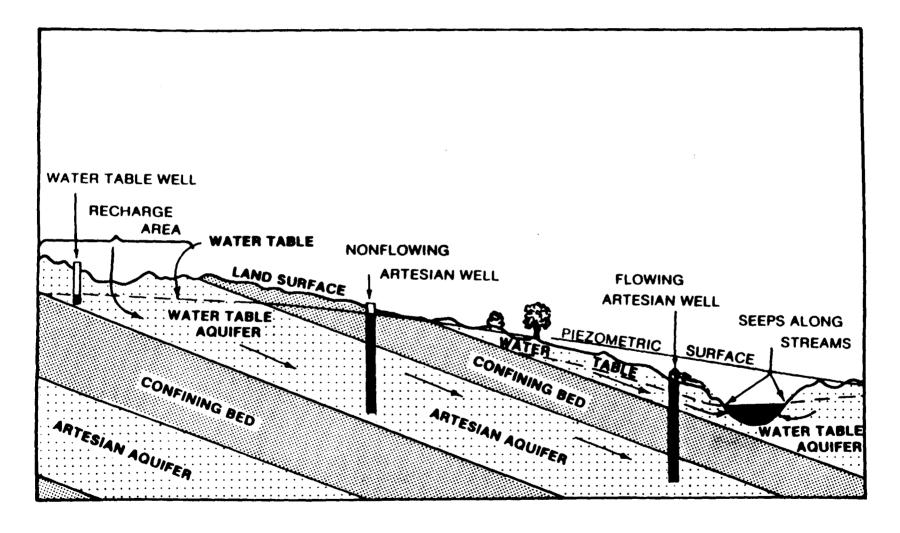


Figure 4.—Diagrammatic illustration of the occurrence of water-table and artesian aquifers (after Barksdale, LaMoreaux, and Knowles, 1968).

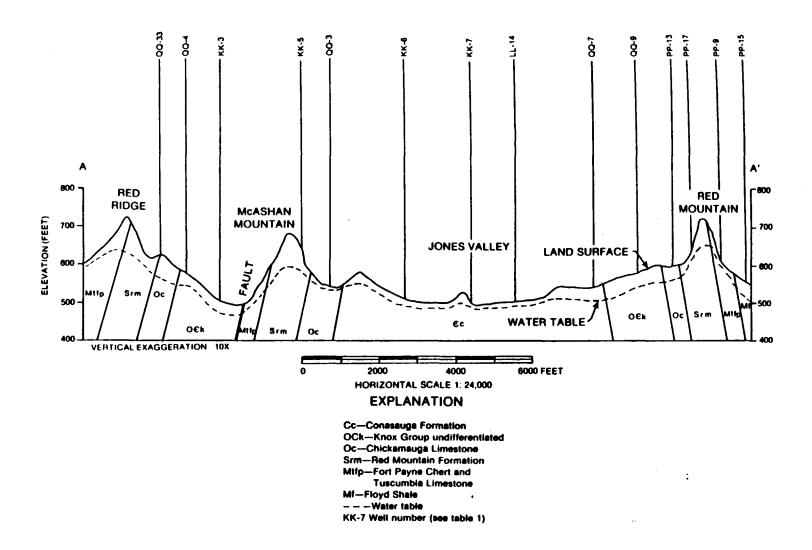


Figure 5.—Hydrogeologic cross-section A-A' across Jones Valley, southwest of Birmingham (plate 1), showing the general configuration of the water table.

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conditions generally occur within the Conasauga Formation where there is no confining layer. Artesian conditions generally occur in the Fort Payne Chert in the areas of Red Ridge and Red Mountain. In these areas, the Fort Payne lies between the impermeable Red Mountain Formation below and the Floyd Shale above. Initially, the water exists under unconfined or water-table conditions. As it moves downward through the formation, however, it becomes confined or artesian. In this artesian zone, unconfined water would rise above the Fort Payne aquifer. The impermeable Floyd Shale serves both as a confining layer and as a barrier to surface contamination of the water in the Fort Payne aquifer.

GROUND WATER-SURFACE WATER RELATIONSHIPS

As has been shown, water-table aquifers are in contact with the atmosphere and there is no confining bed as there is with an artesian aquifer. The absence of a confining bed allows the water table to be in contact with streams. It is important for water-resources management to recognize that streams and the ground-water reservoir are often directly connected. The interconnection of the ground-water and surface-water systems is illustrated in figure 6. The stream on the right

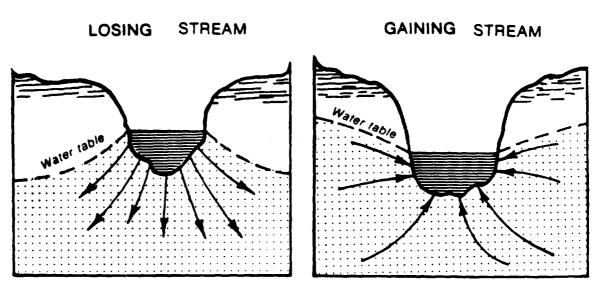


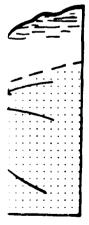
Figure 6.—Diagram showing the relationship between ground water and surface water along a losing (left) and a gaining stream (right).

is called a gaining stream because the aquifer is discharging water into the stream. Some ground water is discharged by aquifers to streams in the Birmingham and Cahaba Valleys throughout the year. During late summer and early fall, most streamflow results from ground-water on where cur in the n. In these Mountain ter exists ownward tesian. In ort Payne ning layer ort Payne

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aterinto reams in ring late id-water discharge. The stream on the left is termed a losing stream because water is being contributed to the water-table aquifer. There are probably no permanently losing streams in Jefferson County. Such conditions could occur, however, as a result of heavy pumping of ground water.

GROUND-WATER USE IN THE BIRMINGHAM AND CAHABA VALLEYS

The ground-water resources of the Birmingham and Cahaba Valleys are presently being used to a limited degree. Those taking advantage of these resources include homeowners who use the water as a domestic supply and industry which utilizes it in manufacturing, in ore extraction, and in heating and cooling. Several public water systems such as those at Roupes Valley and Irondale are supplied by ground water. In addition to these uses, ground water from springs is supplying municipal water systems and recreational needs.

Ground water from domestic wells often serves the total needs of families within the study areas. In many places, however, domestic wells are used in conjunction with a public water supply. When both supplies are available, personal preference often controls the use of each supply. For example, some owners use their wells to supply water for lawns and gardens, to wash cars, etc. and use "city" water for drinking and cooking. Other owners reported a distinct dislike for the taste of treated public water and use the well water only for household purposes. In the more urbanized areas, public water was more desired because of its safety and dependability.

Most of the domestic wells inventoried during this study were 6 inches in diameter, and very few were cased to their total depth. Most of these wells were drilled only deep enough to obtain a 5 to 10 gpm supply for a household. Surface construction generally consisted of 6-inch steel casing that was usually driven a few feet into bedrock. Most domestic wells were equipped with either a jet or a submersible pump.

Some industrial or commercial concerns use ground water for heating and cooling or as process water. For example, Connor's Steel Corporation has two wells in the Ketona Formation that pump an estimated total of 660 gpm. This water is used primarily for cooling steel. Ground water is also used for washing quarried rock. In such a use, much of the total volume pumped usually flows back into the quarry and is reused. For example, in March 1977, Dolcito Quarry used a reported 2,000 gpm in this way. An estimated 1,500 gpm flowed back into the quarry and 500 gpm of water reportedly was released to Five Mile Creek. Eastwood Mall has a well that produces 1 to 1.5 million

gallons per day (mgd) from the Fort Payne Chert. This water is used to heat and cool the mall. The Club in Birmingham has a 110-foot well that pumps a reported 180 gpm from an old iron ore mine. The water is used to cool the facility and is then returned to a nearby mine opening.

In addition to supplying domestic wells and industry, ground water from wells supplies public-water systems at Irondale, Leeds, Roupes Valley, and Trussville. The newest of these systems is that of the Roupes Valley Water Authority near Bucksville. This system has two wells, drilled into the Fort Payne Chert, which yield a reported 750 and 500 gpm each. Approximately 5 million gallons of water per month is being used although the wells could produce much more. As much as 10 million gallons per month were used during the testing of new distribution lines.

Springs in Jefferson County are used as public water supplies, to fill pools, and to maintain ponds in parks. For example, the Leeds Water Board uses three large springs as a part of its municipal supply. These springs were discharging an estimated total of 3,200 gpm of water on April 12, 1977. At that time, approximately 2,200 gpm of water was being withdrawn from the springs for municipal use according to Mr. Fred Scott of the Leeds Water Board. Other springs near Birmingham are being used as small community supplies. Tarrant Spring, near Ketona, supplies a reported 200 families with water, and Clear Springs near Loveless Park supplies a reported 30 families. Smaller springs are used as domestic water supplies.

Several springs in the study areas are being used for aesthetic or recreational purposes. The discharges from some of them maintain ponds or lakes. Subsequently, the water flows into storm drains or nearby streams without further use.

GROUND-WATER DISCHARGES IN THE BIRMINGHAM AND CAHABA VALLEYS

Data collected during this investigation indicate that several wells in the Birmingham and Cahaba Valleys of Jefferson County are capable of producing more than 1 million gallons of water per day. Table 3 gives current ground-water withdrawal rates of the most productive wells that were inventoried during the investigation. Most of the pumping rates shown in the table are those reported by the well owners. Some rates were extrapolated from daily consumption figures; therefore, some of the listed pumpage rates may differ from the actual rate. Six of the wells listed appear capable of producing, if pumped for 24 hours, 1 million gallons of water in a single day. The total pumpage capacity of the 19 sources shown is approximately

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Table 3.—Current major ground-water withdrawal rates from wells inventoried in the Birmingham and Cahaba Valleys of Jefferson County

A. C.—Air conditioning

P. S.—Public supply

Ind.—Industrial

Owner (gpm) Use Irondale Water Works 1200 P. S. Eastwood Mall 1000 P. S. Trussville Water Department 1000 P. S. Leeds Water Board 750 P. S. Roupes Valley Water Authority 700 Ind. Hercules Incorporated 650 P. S. Trussville Water Department 650 P. S. Roupes Valley Water Authority 620 P. S. Roupes Valley Water Authority 620 P. S. Roupes Valley Water Authority 700 Ind. Irondale Water Works 700 Ind. Irondale Water Works 700 Ind. Irondale Water Works 700 Ind. Irondale Water Authority 700 Ind. Irondale Water Works 700 Ind. Ind. Ind. Ind. Ind. Ind. Ind. Ind.			
Irondale Water Works Eastwood Mall Trussville Water Department Leeds Water Board Roupes Valley Water Authority Hercules Incorporated Trussville Water Department The Country Club of Birmingham Irondale Water Works Roupes Valley Water Authority Connor's Steel Corporation Irondale Water Works Connor's Steel Corporation Elmwood Cemetery Irondale Water Works Southern Railroad Birmingham Stove and Range Southern Railroad 1000 P. S. 1000 P. S. 650 P. S. 650 P. S. 630 Ind. 620 P. S. 650 P. S. 650 Ind. 650 Ind. 650 Ind. 650 Ind. 650 Ind.	Owner	_	Use
a malma	Irondale Water Works Eastwood Mall Trussville Water Department Leeds Water Board Roupes Valley Water Authority Hercules Incorporated Trussville Water Department The Country Club of Birmingham Irondale Water Works Roupes Valley Water Authority Connor's Steel Corporation Irondale Water Works Connor's Steel Corporation Elmwood Cemetery Irondale Water Works Southern Railroad Birmingham Stove and Range	1100 1000 1000 750 700 650 630 620 500 390 330 270 200 175 50+ 50	A. C. P. S. P. S. Ind. P. S. Ind. P. S. Ind. P. S. Ind. Ind. Ind. Ind.

^{*}Rate of yield is not maintained on a 24-hour basis for all wells.

9,000 gpm. Thus, these 19 producers of ground water could pump about 13 million gallons of water in a day if they were pumped continuously.

The withdrawal rates listed in table 3 should serve as indicators of the productivity of aquifers within the Birmingham and Cahaba Valleys. The water in these aquifers could be developed through planned exploration and management programs designed by hydrogeologists and engineers along with construction by capable water-well drillers. As will be shown later, the ground-water resources of some areas often can be developed more economically and easily than surface-water resources.

Numerous springs with large discharges were also located during the investigation. A few of them are used as public water supplies. However, most of them are apparently flowing unused into storm drains or streams. Some sustain ponds or lakes and are subsequently released with no consumptive benefit.

Spring flow usually varies throughout the year. As a result, a spring having good flow during the rainy part of the year might have a drastically decreased flow or perhaps even become dry during the late summer and early fall. With this variation in mind, the flows of large springs that were located during the study were estimated at least twice. Initial flow data were collected from February through April 1977. These flow estimates were made either at the time the springs were first located or at the time water-quality samples were collected. A later estimate of the spring flow was made during the first half of June 1977 at a time when no significant rain had fallen in the study areas for the previous two weeks. Because the flow of springs is normally lowest during October and November, the June flow values probably do not represent the lowest flows for the year. They may, however, serve as indicators of the dependability of some of the springs.

A summary of discharge data for those springs whose estimated flows exceeded 100 gpm in June 1977 is shown in table 4. Other measured or estimated flows from previous investigations are included in the table. The springs are listed by approximate decreasing rate of flow. The reported or estimated quantity of water that is being used or consumed is also shown. Few, if any, of these quantities are actually used on a 24-hour basis. When a spring flows through a pond or lake, the quantity of water lost or consumed by infiltration and evaporation is unknown. Such losses are probably insignificant for large springs flowing into small lakes or ponds.

The total of the lowest estimated or reported discharges for the

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Table 4.—Summary of discharge data for springs inventoried in the Birmingham and Cahaba Valleys of Jefferson County

(Data are for springs with discharge equal to or greater than 100 gpm in June 1977)

Owner or name	Dis- charge (gpm)	Quantity consumed (gpm)	Use	Date of measure- ment
Republic Steel Company	13400	0?	Recreation	3-22-77
	13050	0?		3-25-77
	'2030	0?		6-06-77
Ken Nixon				
(Penny Spring)	12500	?	Unknown	3-14-57
	2200	?		6-17-68
	1500	?		10-14-68
	2350	?		5-05-69
	1480	?	•	11-06-69
	3120	?		3-27-70
	1360	?		9-29-70
	2400	?		4-16-71
	2970	?		4-18-73
	3220	?		4-08-74
	3500	?		3-31-75
	1750	?		11-05-76
	12400	Negligible	Stock	2-18-77
	3880	?	Unknown	4-15-77
	13100	Negligible	Stock	6-08-77
Alabama Boys Industrial				
School ⁴	12010	0?	Recreation	2-18-77
	12030	0?		6-06-77
Killough Springs	11800	0	Unused	2-15-77
	11720	O		6-07-77
Spring Lake	11150	0	Recreation	6-07-77
nearby adjoining springs	1230	0	Unused	6-07-77
Leeds Water Board				
(Weems Spring)	²1920	³ 110	P. S. ⁵	4-12-77
	²880	3770		6-07-77
David Glenn				
(Glenn Springs)4	11750	0	Unused	3-25-77
	1550	0		6-08-77
Avondale Spring	11380	0	Recreation	3-23-77
Thomas opining	1250	Ŏ	-	6-06-77

Table 4.—Summary of discharge data for springs inventoried in the Birmingham and Cahaba Valleys of Jefferson County - continued

Owner or name	Dis- charge (gpm)	Quantity consumed (gpm)	Use	Date of measure- ment
Prince Spring	1950	0	Unused	3-25-77
	1250			6-06-77
Caldwell Spring	490			6-17-68
o and the second of the second	370			10-14-68
	1090			5-09-69
	360			11-06-69
	1260			3-26-70
	390			9-29-70
	1320			4-16-71
	720			4-18-73
	860			4-08-74
	1550		•	3-31-75
	660			6-17-76
	420			11-05-76
	1890	0	Unused	2-16-77
	880	0	Unused	4-15-77
	1660	0	Unused	120 6-07-77
Leeds Water Board				
(Cedar Grove Spring)	² 540	³360	P. S.	4-12-77
·	² 410	³ 350	P. S.	6-07-77
Jefferson County				
(Tarrant Spring)	² 510	³ 60	P. S.	3-24-77
	²240	³ 60		6-07-77
Moore's Spring	1450	0	Unused	6-06-77
Leeds Water Board				
(Rowan Spring)	²375	?	P. S.	2-28-57
	² 815	³715		4-12-77
	²420	3420		6-07-77
City of Bessemer	_ ·-	<u> </u>		
(Hawkins Spring)	1300	0	Recreation	3-08-77
	150	Ŏ		6-06-77

^{&#}x27;Estimated Discharge

²Discharge based on estimated excess flow and reported pumping data combined

³Quantity not consumed on 24-hour basis

^{*}Rare and endangered species (Watercress darter) lives in spring

⁵P. S.—Public Supply

1977, respectively. It is doubtful that this spring sustains a flow in excess of 1,000 gpm for any length of time. The higher estimated flow was determined after heavy rains in the Birmingham area. Caldwell Spring had an estimated flow of 650 gpm or slightly less than 1 mgd on June 7, 1977.

Moore's Spring reportedly once supplied a swimming pool with water. The spring, which is located near Highway 150 in Bessemer, was later covered and its flow directed to a storm drain. On June 6, 1977, the estimated discharge from this spring was 450 gpm or about 0.6 mgd. Additional information is needed on this spring because the estimate was made in a ditch where the spring water flowed from the storm drain. Additional water from other sources could have been included in the estimate; however, these sources could not be determined solely by a surface investigation of the area. Tarrant Spring, which flows from property reportedly owned by Jefferson County, was discharging an estimated 510 gpm and 240 gpm on March 24 and June 7, 1977, respectively. These discharges are equivalent to 0.7 and 0.3 mgd, respectively.

Hawkins Springs, which once supplied Bessemer's public water supply, was flowing an estimated 300 gpm and 150 gpm on March 8 and June 6, 1977, respectively. This spring yielded an average of about 2 mgd in the early 1900's according to Johnston (1933). He reported that the spring was test pumped at 4.8 mgd on August 26, 1926. The spring is reported to have failed on October 5, 1927. It currently maintains a pond at the Midfield Community Center.

Collectively, the springs discussed above discharge significant quantities of water each day. Serious consideration should be given to identifying methods of utilizing these waters. There would be little or no exploration cost involved in the development of these sources of water as there would be for the test drilling programs necessary to develop large capacity wells.

Chlorination and softening by treatment or possibly dilution should ready these spring waters for most uses. Iron removal might also be necessary for some of the water. Another factor to consider prior to developing these sources of water is whether the diversion of a large percentage of a particular spring's flow will result in any deleterious downstream effects. For example, it would be unwise to reduce the flow of a spring that contributes a large part of a nearby stream's total flow. If the stream were receiving any chemical or organic waste load, the results could be serious. Nevertheless, the investigation of methods of using these springs is warranted because the benefits to be derived could be substantial.

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WELLS

As has already been noted, wells drilled in limestone and dolomite, and to a lesser extent in sandstone, must encounter secondary water-bearing openings to be productive. Such openings do not occur everywhere, and their size and number generally decrease with increasing depth. It follows that the best available hydrogeologic skills should be applied to the selection of a well site, especially if a large yield is needed. Household or other relatively small supplies often can be obtained from the residuum overlying the rock or from the upper weathered part of the rock. However, larger supplies generally must be sought at greater depths, and it is here that both skill in selecting the site and an element of luck become important. Drilling to depths of more than 300 feet in consolidated rocks is generally not recommended.

This section includes a series of analytical summaries designed to provide a better understanding of the overall pattern of well construction in the study area. Hopefully, it will be useful to those intending to seek a supply of ground water. It should be noted, however, that the summaries are based entirely upon successful wells. Unsuccessful wells are seldom reported. The data are insufficient to permit even an estimate of the frequency of failures.

The depth to which a well must be drilled to obtain a satisfactory supply of water is of primary importance to the landowner because of the cost of drilling. This factor, as well as casing length and pump cost, must be considered in studying the economic feasibility of a well. Data collected on depths, yields, and length of casing for wells in the carbonate rocks and the Hartselle Sandstone in the study areas are summarized below. The summaries include data reported by Spigner (1975) and Knight (1976). Although unit costs vary from time to time, these summaries should be useful to persons interested in estimating the average cost of drilling wells in the area.

DEPTHS

Depths reported for all wells (drilled and dug) inventoried in the Birmingham and Cahaba Valleys range from 20 to 620 feet. The median depth for all the wells was 160 feet. Figure 7 is a frequency plot showing the percentage distribution of the well depths. It shows that 80 percent of the wells had a depth equal to or greater than 86 feet and only 20 percent of all wells had depths that equaled or exceeded 300 feet.

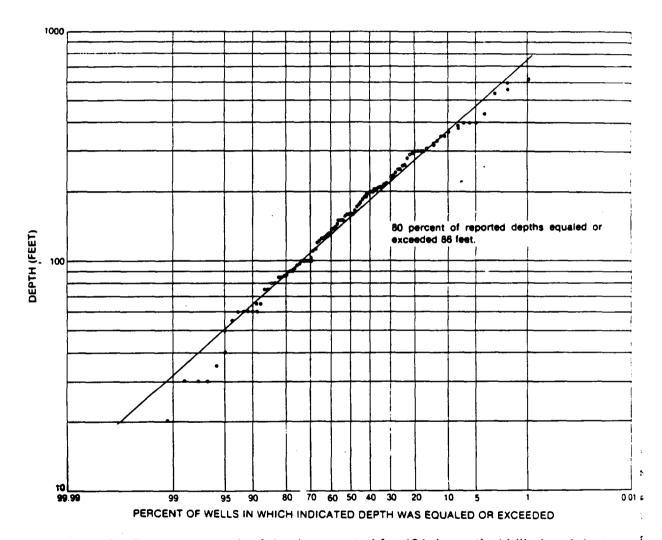


Figure 7.—Frequency graph of depths reported for 131 domestic (drilled and dug), municipal, and industrial wells in the Birmingham and Cahaba Valleys of Jefferson County. (Data are for the carbonate-rock and Hartselle Sandstone aquifers only.)

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Depths of 67 drilled domestic wells inventoried ranged from 30 to 600 feet. The median depth was 121 feet. Figure 8 is a frequency graph of drilled domestic well depths. The graph shows that approximately 85 percent of the wells studied equaled or exceeded 60 feet in depth, whereas only about 20 percent had depths greater than 200 feet. Thus, a majority of the well owners were apparently able to get satisfactory domestic supplies at depths of 60 to 200 feet. Municipal and industrial wells in the study areas generally are not deeper than 400 feet.

YIELDS

The well yields compiled during this investigation are based on yields measured during sample collection, on reports by well owners or drillers, and on previously published data. The individual well owner usually reports the yield estimated by the driller. Reported domestic well yields in the study areas ranged from a low of 2.5 gpm to a high of 22 gpm. The median yield was 7.1 gpm. The frequency graph of domestic well yields shown in figure 9 indicates that more than 70 percent of the wells studied had yields equal to or greater than 5 gpm, which is usually considered adequate for most families. If the data presented in figure 8 correctly represent conditions in the study areas, they may be used to predict the likelihood that a well drilled at a randomly selected site would yield a quantity of water adequate for most domestic purposes from a depth less than 200 feet. The data in figure 9 indicate the low probability of getting a domestic well with a large yield (20 or more gpm) at a randomly selected site.

Yields for domestic wells can sometimes be misleading if one uses the data to characterize an aquifer's properties. The yields can be deceptive because drillers generally stop drilling as soon as an adequate supply of water is obtained. For example, one well may produce 10 gpm from a total depth of 50 feet whereas another well produces the same amount from a total depth of 200 feet. Therefore, some method is needed to gain a more reliable interpretation of the well-yield data.

The specific capacity of a well is computed by dividing the yield in gallons per minute by the drawdown in lowering of the water level by the pumping process. Specific capacity, then, is reported in gallons per minute per foot of drawdown (gpm/ft). Specific capacity generally varies with the time pumped because water levels usually continue to decline at a progressively slower rate as pumping time increases while the pumping rate remains relatively constant. The most reliable specific capacities are obtained from municipal and industrial wells

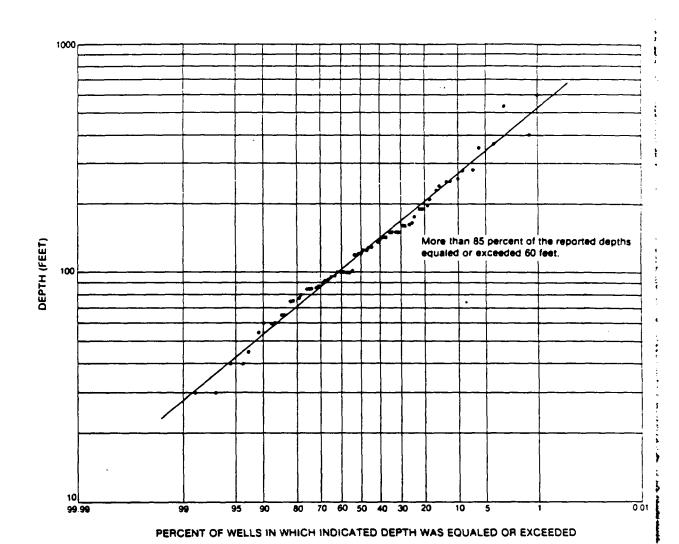
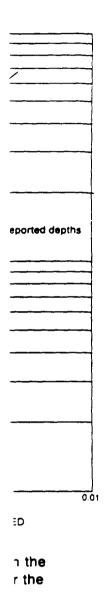


Figure 8.—Frequency graph of depths reported for 67 drilled domestic wells in the Birmingham and Cahaba Valleys of Jefferson County. (Data are for the carbonate-rock and Hartselle Sandstone aquifers only.)



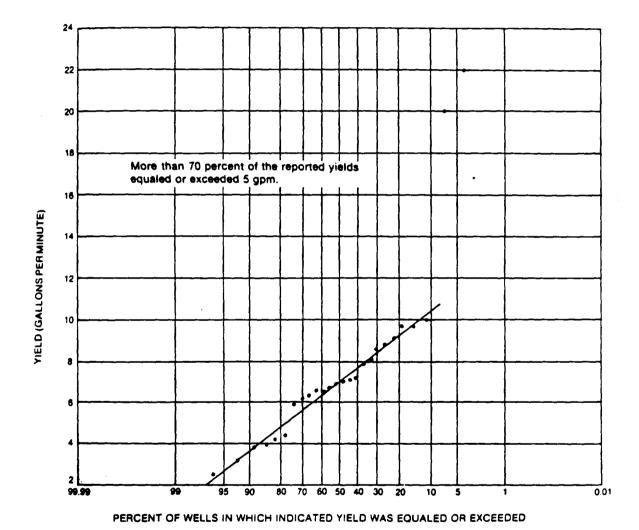


Figure 9.—Frequency graph of yields reported or measured for 27 drilled domestic wells in the Birmingham and Cahaba Valleys of Jefferson County. (Data are for the carbonate aquifers only.)

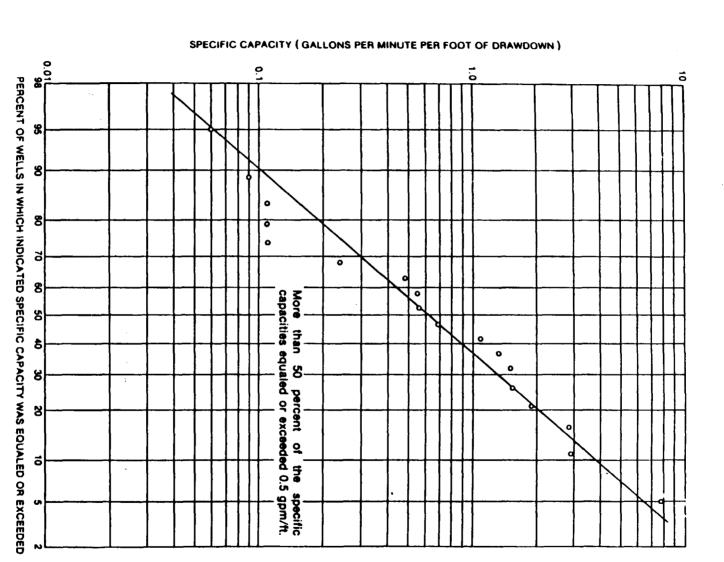
Specific-capacity data reported for this investigation should be regarded only as an indicator of aquifer characteristics because most of the specific capacities reported for domestic wells were based on pumping tests of 30 minutes or less. The pumping times used to calculate each specific capacity are reported in table 1 along with the measured drawdowns and yields of the wells.

For domestic wells, specific-capacity values based on 15-, 30-, and 60-minute pumping times varied from 0.1 to 8 gallons per minute per foot of drawdown. The median specific capacity was 0.6 gpm/ft. A specific capacity of 0.6 gpm/ft indicates that a drawdown of 10 feet would produce about 6 gpm of water. Likewise, a drawdown of 50 feet would produce about 30 gpm of water.

Figure 10 is a frequency graph of specific-capacity data for 18 domestic wells inventoried during this investigation. The data are for carbonate-rock aquifers only. The plot indicates that, of the wells studied, more than 50 percent had specific capacities that equaled or exceeded 0.5 gpm/ft. The data, if they are representative of the aquifer characteristics in the study areas, indicate that there is approximately a 50 percent chance of obtaining a specific capacity of at least 0.5 gpm/ft from a randomly selected site in carbonate rocks.

Aguifers chosen to supply municipal and industrial wells are not randomly selected. Test drilling programs are conducted to determine if the aquifer being considered will yield a specified quantity of water. For this report, a yield of 50 gpm was selected as the lower limit for classifying a well as municipal or industrial. The rate of yield for such wells in the carbonate-rock and Hartselle Sandstone aquifers in the study areas ranged from 50 gpm to a reported high of 1,200 gpm. Figure 11 is a graph that shows the percentage distribution of reported yields for these large capacity wells. The plot indicates that 75 percent of the yields equaled or exceeded 150 gpm and that 20 percent of the vields equaled or exceeded 600 gpm. A vield of 600 gpm would be approximately 0.9 mgd. The median yield, 290 gpm, is approximately 0.4 mgd. These values represent not only reported yields of wells that are presently pumping but also the yields of wells that are now destroyed or unused. Yield values from unused or destroyed wells were included because they reflect the productivity of the aquifer.

Specific capacities for high-yielding wells were not evaluated because most of the data were obtained from wells tapping a single aquifer, the Fort Payne Chert-Tuscumbia Limestone aquifer. Therefore, these data do not represent the overall aquifer characteristics throughout the study areas.



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Figure 10.—Frequency graph of specific-capacity data for 18 domestic wells in the Birmingham and Cahaba Valleys of Jefferson County. (Data are for the carbonate aquifers only.)

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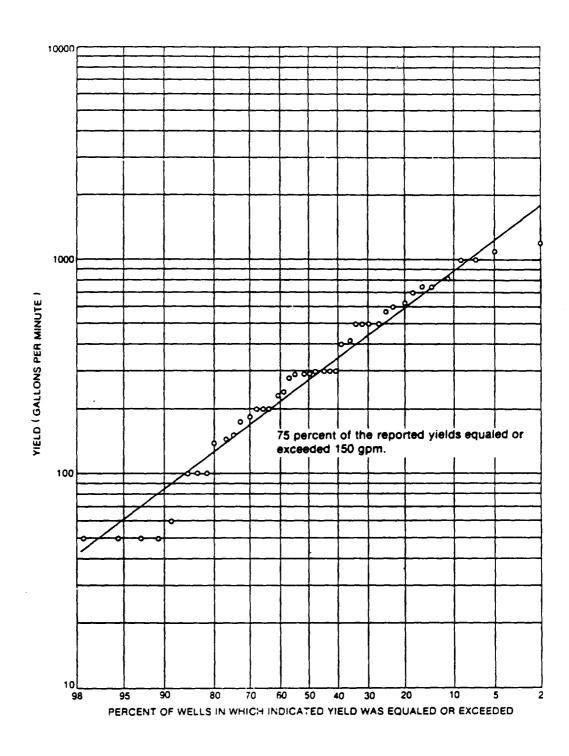


Figure 11.—Frequency graph of reported yields for 43 municipal and industrial wells in the Birmingham and Cahaba Valleys of Jefferson County. (Data are for the carbonate-rock and Hartselle Sandstone aquifers only.)

A large percentage of domestic wells drilled into bedrock in Alabama are not cased to their total depths. Instead, the casing (usually 6-inch steel) is driven only a few feet into the bedrock and is used primarily to keep soil materials above the bedrock from caving. In this construction method, no screen is installed in the well. Such wells are referred to as open-end or open-hole wells.

Casing depths for domestic wells in the study area ranged from 3.5 to 250 feet. The median depth was 40 feet. The frequency plot of casing depths shown in figure 12 indicates that more than 75 percent of the wells had casing depths that equaled or exceeded 20 feet. Twenty percent of the wells had casing that extended to a depth of 70 feet or more.

WATER-BEARING CHARACTERISTICS OF THE AQUIFERS

The following sections contain summaries of the data collected on yields, specific capacities, and spring flows for each aquifer in the Birmingham and Cahaba Valleys of Jefferson County. The summaries can only serve as indicators of the potential productivity of the various units owing to the paucity of data. This lack of data reflects the limited use of ground water within the study areas.

Reported well yields, excluding those for domestic wells ranged from 50 to 1,350 gpm. Specific-capacity values for all wells ranged from 0.1 to 65 gpm/ft. Wells in the Fort Payne Chert-Tuscumbia Limestone and the Bangor Limestone aquifers had the highest specific capacities. The Knox Group aquifer had the lowest specific capacity.

Some aquifers in the study areas appear to have great potential as sources of ground water. The Fort Payne Chert-Tuscumbia Limestone aquifer is probably best suited for immediate development because its geologic properties greatly increase the likelihood of obtaining a successful well. This aquifer currently sustains large production wells in the study areas. The exploration and development costs necessary to establish high-capacity wells would probably be less than for any of the other aquifers.

CONASAUGA FORMATION

The Conasauga Formation yields large quantities of water to wells and springs in the study areas. The availability of water from the formation is, however, unpredictable. In a line of wells across the formation at the couthwest odds of lefferon County the water yields

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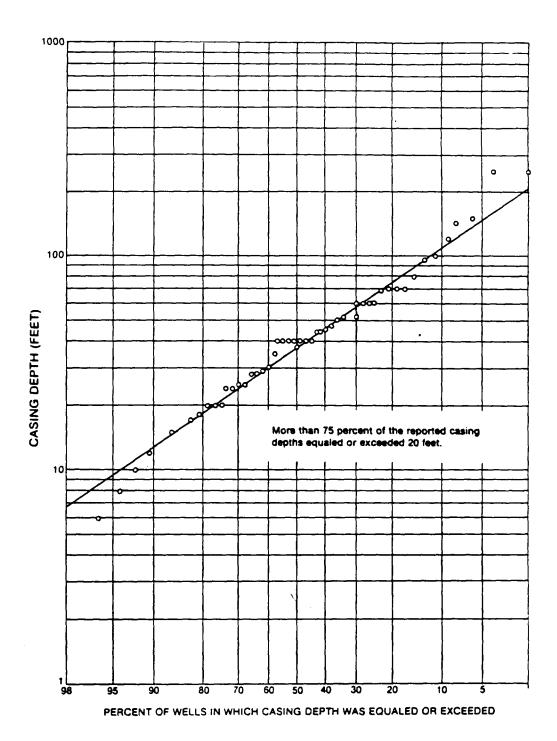


Figure 12.—Frequency graph of reported casing depths for 52 drilled domestic wells in the Birmingham and Cahaba Valleys of Jefferson County. (Data are for the carbonate-rock and Hartselle Sandstone aquifers only.)

vary greatly. Three wells along this line yield significantly more water than is normally required for one household. A fourth well produces only enough water for one family. The fifth, drilled to a depth of 600 feet, continued to be a failure even after it was dynamited several times. Johnston (1933) and Robinson, Ivey, and Billingsley (1953) reported yields between 55 and 300 gpm for wells tapping the Conasauga in Jefferson County. Knight (1976) reported yields that ranged from 60 to 300 gpm for six industrial wells producing from the Conasauga. No specific-capacity data were available for large wells producing from this aquifer. A domestic well was tested and found to have a specific capacity of 8 gpm/ft. This was the highest specific capacity of any of the domestic wells tested.

Four Conasauga springs, including Hawkins Spring, examined during this investigation had estimated springtime discharges between 150 and 3,400 gpm. Johnston (1933) gave an interesting account of Hawkins Spring, which had a yield of 1,300 gpm when he inspected it. The spring had been a public supply source since 1891 and had furnished Bessemer with an average of 2 mgd in the 1920's. During a test in August 1926, it yielded 4.8 million gallons. Hawkins Spring failed in October 1927, and a pipeline was constructed to bring water from Birmingham to Bessemer. The spring now maintains a small pond at the park in Midfield.

The above data indicate that the Conasauga will yield very large quantities of ground water; however, the porosity and permeability of the formation is possibly localized along solution channels. Further study is needed to identify ways of locating successful wells in this aquifer because of the apparent variability of yields.

KETONA DOLOMITE

Well and spring data indicate that the Ketona Dolomite is a major producer of water and deserves further investigation. Caution must be exercised in the development of the Ketona, however, because its outcrop is peculiarly susceptible to the formation of sinkholes. The development of the large quantities of unused water from springs associated with the Ketona should be considered. The use of the existing spring flows should not cause any additional sinkhole problems.

The results of two specific-capacity tests of 15- and 30-minutes duration were 0.1 and 1 gpm/ft. Three inventoried industrial wells were pumping at reported rates of 50, 270, and 390 gpm. Two other unused industrial wells had reported yields of 4 and 60 gpm. Another well was

ells in or the

However, it could not be determined if this well produces from the Ketona and/or from the Conasauga Formation. Dolcito quarry in the Ketona at Tarrant City reported a withdrawal pumping rate of 500 gpm. This high yield results from seepage into a large pit created by excavation. Knight (1976) reported two well yields of 150 and 200 gpm for the Ketona. He reported data indicating that the 150-gpm well had a specific capacity of 4.3 gpm/ft.

Five large springs were located that had estimated springtime flows between 500 and 2,000 gpm. Two of the five springs had estimated discharges greater than 1,000 gpm in June 1977. The largest spring occurred at the contact of the Ketona with the Conasauga Formation. Two other springs occurred at a contact with the Knox Group. Most of the water flowing from these springs was unused. Knight (1976) reported a flow of 500 gpm for a Ketona-Knox Group contact spring.

KNOX GROUP UNDIFFERENTIATED

The location of sites for high-yield wells in dolomites of the Knox Group will probably be difficult even though spring yields indicate that large quantities of water may be available from this unit. The relationship of spring yields to the geology of the Knox needs further investigation to help locate high-yielding wells. The Knox Group is characterized by a thick porous cherty soil that supplies water to dug wells and acts as a reservoir releasing water to the underlying rocks.

Six domestic wells in the Knox were tested during this investigation and the 15- and 30-minute specific capacities ranged from 0.1 to 2 and averaged 0.5 gpm/ft. No high-yielding wells were located during this investigation, but Robinson, Ivey, and Billingsley (1953) reported that wells in the Copper Ridge Dolomite, which is in the Knox Group, yielded more than 150 gpm. Knight (1976) reported yields of 145, 230, and 750 gpm for three large-capacity wells that produced water from the Knox Group. Specific capacities for the 145- and 230-gpm wells were 1 and 2 gpm/ft, respectively. Knight also reported a fourth well that was test-pumped at a maximum rate of 820 gpm for 21 hours. Available data indicate that this well had a specific capacity of about 40 gpm/ft.

During the present study, several springs were located that had estimated or reported springtime flows of between 30 and 3,900 gpm. One large spring that discharges from the Knox had an estimated flow of 3,100 gpm on June 8, 1977. The U. S. Geological Survey has collected 12 flow measurements for this spring since 1968. The average discharge was 2,480 gpm (about 3.6 mgd). The highest measured flow was 3,900 gpm in April 1977; the lowest was 1,360 gpm

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ORDOVICIAN LIMESTONES UNDIFFERENTIATED

Ordovician limestones occur in the Cahaba Valley and yield large quantities of water to springs. Three large springs in these limestones were discharging 500, 800, and 1,900 gpm each on April 12, 1977. Their combined flow was equivalent to about 3 mgd. These springs are currently being used by the Leeds Water Board as a part of its public water supply system.

The potential yield of wells tapping these limestones cannot be adequately predicted due to the paucity of information. Two domestic wells that were tested during this investigation had specific capacities of 2 gpm/ft. Spring flows indicate that large quantities of water may be available, but further study is needed to ascertain the hydrogeologic framework responsible for the discharges.

CHICKAMAUGA LIMESTONE

Very little information is available on the yields of wells and springs in the Chickamauga Limestone. One spring had a yield of about 30 gpm in December 1976 according to its owner. Three domestic wells were tested that had yields of 3, 7, and 7 gpm. These wells had 15- or 30-minute specific capacities of 1, 0.1, and 3 gpm/ft, respectively. Two other Chickamauga wells had reported yields of 140 and 700 gpm. The 700 gpm well, which is located in a complexly faulted zone, is currently being used for an industrial supply.

The Chickamauga Limestone probably does not have a well-developed cavity system; therefore, large-capacity wells would be difficult to locate. Wells with yields as much as 200 gpm are probably possible and greater yields might be obtained along fault zones.

FORT PAYNE CHERT - TUSCUMBIA LIMESTONE

Spigner (1975), in a ground-water study of approximately 30 square miles on the southeast flank of the Birmingham anticline in Jefferson County, reported that Fort Payne-Tuscumbia wells were highly successful. He reported that 14 of 20 wells drilled in the area since 1936 were successfully completed as municipal or industrial wells. He also reported that each of the 6 remaining test wells had reported yields of 40 gpm or more. Spigner's investigation also showed that large-capacity wells at Irondale and Eastwood Mall in

Data collected or examined during this investigation showed that yields of Fort Payne-Tuscumbia wells ranged from 8 gpm for a domestic well to 1,200 gpm for a public supply well at Irondale. Reported municipal-industrial yields ranged from 155 to 1,200 gpm and had a median value of 500 gpm. Figure 13 is a frequency plot of reported yields of municipal-industrial wells tapping the Fort Payne-Tuscumbia aquifer in the study areas. It shows that approximately 80 percent of the wells had yields equal to or greater than 230 gpm. Twenty percent had yields equal to or greater than 800 gpm.

Two 6-inch domestic wells, pumped for 30 minutes, had specific capacities of 2 and 3 gpm/ft, which is relatively high for their areas. Spigner (1975) reported a range in specific capacities from 0.4 to 20 gpm/ft from pumping tests on 11 completed wells and two test wells. The median specific capacity for Spigner's summary was 7 gpm/ft and the average value was 8.5 gpm/ft. Four other specific capacities determined during this investigation were 10, 12, 22, and 65 gpm/ft for 24-hour tests at 500, 1100, 750, and 750 gpm, respectively. Two springs that discharge from the Fort Payne-Tuscumbia aquifer had estimated yields of 15 and 40 gpm in June 1977. A third spring was discharging an estimated 45 gpm on December 1976.

The data summarized above indicate that the Fort Payne-Tuscumbia is probably the best aquifer in the study areas because it sustains a large number of high-yield wells. The chances of obtaining a successful well in this aquifer are high because it apparently has a more interconnected and diffuse network of solution openings and fractures than do other limestone and dolomite aquifers in the areas. The aquifer also has the advantage that it is confined by two formations that form barriers against contamination and subsidence. Furthermore, artesian conditions within the aquifer tend to reduce pumping costs by reducing the distance that the water must be lifted.

HARTSELLE SANDSTONE

The primary sources of ground water in the Hartselle Sandstone are thought to be joints, fractures, and poorly cemented zones. Location of these producing zones would necessitate careful geologic study prior to a serious test drilling program. Such a study would involve the examination of exposures of the formation and the study of geologic maps in an attempt to find areas having porosity and permeability adequate to produce water. The most favorable areas would probably be those where the Hartselle has been deformed by folding and faulting

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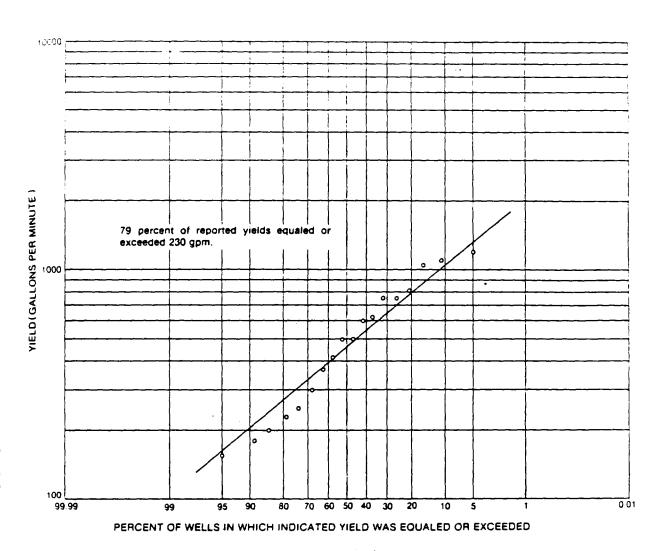


Figure 13.—Frequency graph of reported yields for 18 municipal and industrial wells in the Fort Payne Chert-Tuscumbia Limestone aquifer in the Birmingham and Cahaba Valleys of Jefferson County. (Data are those from this study and that of Spigner, 1975.)

Large yields of ground water are reported for the Hartselle Sandstone. Five yields reported during this investigation ranged from 100 to 500 gpm. The 500 gpm well probably produces water partly from the Bangor Limestone. Therefore, the Hartselle Sandstone itself may not be able to produce 500 gpm from a single well. Spigner (1975) reported that three shallow wells in the Hartselle produced a combined supply of 600 to 1,000 gpm. He reported a theoretical specific capacity of 22 gpm/ft for one of these wells. Knight (1976) reported that two Hartselle wells were test pumped at 1,200 and 1,350 gpm each. However, no record could be found to indicate that these rates of pumpage could be sustained for production purposes, and they are thought not be representative of wells in the Hartselle. Two industrial wells drawing from the Hartselle have been highly reliable, producing an estimated 50 to 100 gpm each for about 20 years. These wells may also draw some water from the Bangor Limestone.

BANGOR LIMESTONE

The Bangor Limestone supplies large quantities of water to wells. It is thought that much of the permeability and porosity of the Bangor is associated with vertical or near-vertical fractures and joints. The Bangor has a history of problems associated with turbidity, subsidence, contamination, and severe drilling difficulties, and great care must be exercised in the location and construction of wells. Spigner (1975) concluded that these problems probably result from the highly weathered nature of the upper part of the formation and the shallow depths to water.

Pumping rates of 50 to 630 gpm have been reported for 7 wells that draw water from the Bangor. Five of the pumping rates were greater than 250 gpm. A domestic well tested during this investigation had a specific capacity of 0.4 gpm/ft. Spigner (1975) reported specific capacities of 8.7, 30, and 50 gpm/ft for wells with pumping rates of 600, 350, and 620 gpm, respectively. Pumping-test data from a well at The Country Club of Birmingham indicated a specific capacity of 20 gpm/ft after 30 hours of pumping at 630 gpm in 1959. A spring flowing from the Bangor had a discharge of approximately 120 gpm. The data given above indicate an aquifer capable of producing substantial quantities of water.

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WATER QUALITY

The chemical quality of ground water is controlled primarily by the nature of the materials with which the water is in contact. The generally slow movement of ground water within geologic formations results in greater contact times with the rocks and causes ground water to have a higher dissolved mineral content than surface water. Ground water generally does not contain bacteria or suspended matter as does much surface water. The most common natural problems associated with the chemical quality of ground water are hardness, dissolved-solids concentration, iron concentration, and pH. Ground-water quality may also be affected by land use such as sewage disposal, industrial waste disposal, and agriculture. In spite of such problems, ground water can generally be used for most industrial and municipal purposes with only minimum treatment.

As a part of this investigation, 64 samples of ground water were collected for chemical analysis. Of this number, 38 samples were collected from wells and the remaining 26 samples were collected from springs. Sixty-two samples were taken from the carbonate rocks in the study areas. One sample was collected from the non-carbonate Hartselle Sandstone, and one sample was collected from a mine drainage well. The results of the analysis of the sample from the mine drainage well has not been included in any of the data summaries discussed below because the water was thought to come from the Red Mountain Formation which is not a significant aquifer.

Table 5 is a summary of the minimum, maximum, median, and average concentrations of the chemical constituents in the water samples collected from the aquifers within the study areas. A tabulation of the number of samples collected from each formation is shown beneath the table. The summary indicates that the waters in the study areas are chiefly of the calcium bicarbonate type. The major cations occurring in these samples in decreasing order of abundance were: calcium, magnesium, sodium, and potassium. The major anions in decreasing order of abundance were: bicarbonate, sulfate, chloride, nitrate, phosphate, and fluoride.

The data in table 5 were compared with the drinking-water standards of the U. S. Public Health Service (1962). Iron was the only constituent that exceeded the recommended limits for drinking water. However, only 14 percent of the water samples exceeded the 0.3 milligrams per liter (mg/l) limit. Sixty-eight percent of the water samples had iron concentrations that ranged from 0 to 0.05 mg/l. Only 16 percent of the samples from wells and 12 percent of the samples

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Table 5.—Summary of chemical and physical characteristics of ground water from aquifers in the Birmingham and Cahaba Valleys of Jefferson County

Constituent or property	Number of	Concentration*			
	samples	Minimum	Median	Maximum	Average
Silica (SiO ₂)	63	1.8	9.0	29	9.0
Iron (Fe)	63	0	.02	1.3	0.14
Calcium (Ca)	63	11	41	120	44
Magnesium (Mg)	63	0.7	8.6	43	11.8
Sodium (Na)	63	0.6	2.1	26	3.8
Potassium (K)	63	0.2	0.7	14	1.2
Bicarbonate (HCO ₃)	63	18	170	410	179
Carbonate (CO ₃)	63	0	0	0	0
Sulfate (SO ₄)	41	1.2	8.4	120	14.4
Phosphate (PO₄)	62	0	0.04	· 0.31	0.05
100Chloride (Cl)	63	0	4.2	47	6
Fluoride (F)	63	0	0	0.3	0.02
Nitrate (NO ₃)	63	0	3.7	22	5.5
Nitrate as N	63	0	0.84	5	1.25
Dissolved Solids	26	72	163	397	184
Calcium-magnesium					
hardness as CaCO ₃	63	48	140	390	158
Noncarbonate hardness					
as CaCO,	63	. 0	6	110	13
Specific conductance					
(micromhos at 25°C)	62	96	268	751	306
pH	63	6.3	7.3	7.9	7.2
Temperature (°C)	62	13	17	19	16.5

Formation and number of samples: Conasauga (7), Ketona (12), Ketona-Conasauga contact (3), Knox Group-Ketona contact (1), Knox Group-Conasauga contact (1), Knox Group (16), Chickamauga (4), Ordovician undifferentiated (4), Tuscumbia-Fort Payne (9), Pride Mountain-Tuscumbia, Fort Payne contact (1), Hartselle (1), Bangor (4).

^{*}Concentrations in milligrams per liter, except specific conductance, temperature, and pH.

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High nitrate concentrations in ground water can indicate organic contamination from feed lots, cesspools, and sewage. High concentrations of nitrate may also result from the use of fertilizers. In drinking water, the recommended limit of nitrate, expressed as nitrogen, is 10 mg/l. A breakdown of the results of nitrate-nitrogen analyses are shown in table 6. None of the samples of water from the Birmingham and Cahaba Valleys had nitrate-nitrogen concentrations above the recommended drinking-water standard. Some of the values were, however, above normal background concentration of 0 to 1 mg/l.

Table 6.—Summary of the nitrate-nitrogen analyses of water samples from wells and springs in the Birmingham and Cahaba Valleys of Jefferson County*

Range (mg/l)	Percent of Samples
0-1	57
1-2	22
2-3	13
3-4	5
4-5	3
	
	100

*Total number of samples-63.

Specific conductance is a measure of the ability of water to conduct an electric current. This ability is directly related to the total concentration of ionic constituents in the water and, as a result, specific conductance can be used to estimate the dissolved-solids content of natural waters. Rainwater and Thatcher (1960, p. 84) found that the dissolved-solids content of natural water can usually be estimated by multiplying specific conductance by 0.65. Figure 14 is a plot of specific conductance (as determined in the field at the time of sample collection) and dissolved-solids concentrations determined in the laboratory for water samples from carbonate aquifers in the study areas. As can be seen, there is a direct correlation of specific conductance with the dissolved-solids concentrations of the samples. A statistical analysis of the degree of correlation between specific conductance and dissolved solids for the samples resulted in a coefficient of determination of 0.97 with a standard error of 12 mg/l of dissolved solids. These results indicate that the dissolved-solids content of carbonate waters in the study areas can be estimated by multiplying field measurements of specific conductance by 0.60

Hardness is another chemical characteristic that is important in the utilization of water. Hardness is generally understood to be the soap-consuming capacity of water. Soap is precipitated by ions of calcium, magnesium, aluminum, iron, manganese, strontium, zinc, and hydrogen. However, only calcium and magnesium are usually present in natural water in large enough quantities to affect hardness. Therefore, the reported hardness results mainly from the calcium and magnesium ions.

Hardness occurs in two forms as carbonate and noncarbonate hardness. Carbonate hardness refers primarily to the hardness caused by combinations of calcium and magnesium ions with carbonate and bicarbonate ions. Noncarbonate hardness refers primarily to that caused by combinations of calcium and magnesium with sulfates, chlorides, and/or nitrates. Both types of hardness can occur in the same water.

Figure 15 is a graphical representation of the range of maximum hardness and dissolved-solids limits for various uses of water. Also shown are the percentages of wells and springs sampled that would supply water suitable for a specific purpose. For example, 69 percent of the wells sampled and 92 percent of the springs would yield water of suitable hardness for pulp and paper making.

Figure 16 is a plot of specific conductance as recorded at the collection site and of total hardness represented by calcium carbonate concentration of water samples from the carbonate aquifers. A statistical analysis of the degree of correlation between specific conductance and total hardness resulted in a coefficient of determination of 0.92 with a standard error of estimate of 25 mg/l of hardness. Analysis of these data shows that the field determination of specific conductance could be used to estimate hardness by multiplying by 0.60 and subtracting 10.

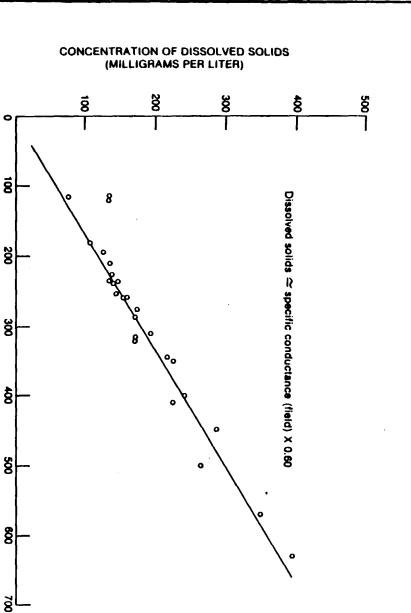
Results of the chemical analyses indicate that, for the parameters analyzed, no significant chemical contamination is generally present in the aquifers of the Birmingham and Cahaba Valleys of Jefferson County. Iron was the only constituent whose concentration exceeded recommended drinking-water standards. Nitrate parameters were higher than normal background concentrations but did not exceed drinking-water limits. Some users might object to the water's hardness. Treatment and/or dilution with water from other sources, if available, could be used to reduce the high iron content and hardness to acceptable levels. The results of the analyses indicate that the ground water in the study areas could be used for industrial, municipal or domestic consumption with little treatment.

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Figure 14.--Relationship of dissolved-solids concentration to specific conductance (field) of water samples from carbonate aquifers in the Birmingham and Cahaba Valleys of Jefferson County.

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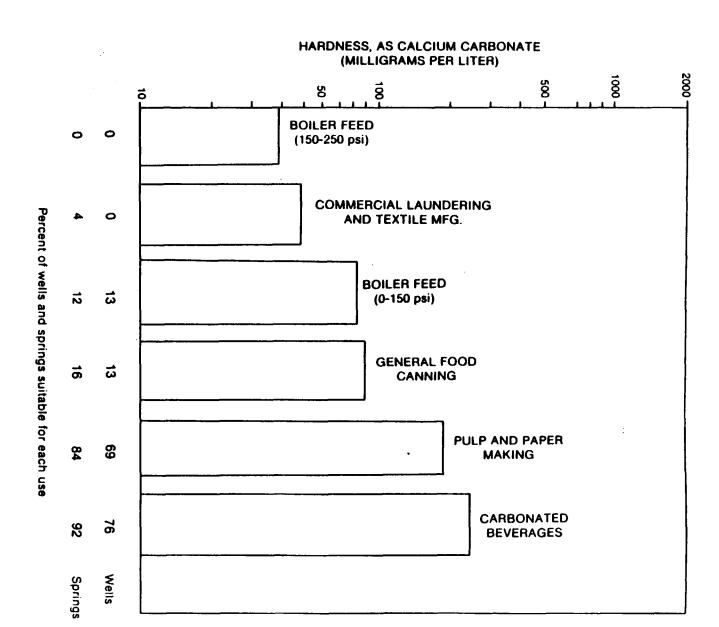


Figure 15.—Graph of water-hardness ranges suitable for various uses and the percent of carbonate aquifers. (Adapted from McKee and Wolf, 1963.) Valleys suitable for each use. The data are for 62 samples from the water samples from wells and springs in the Birmingham and Cahaba



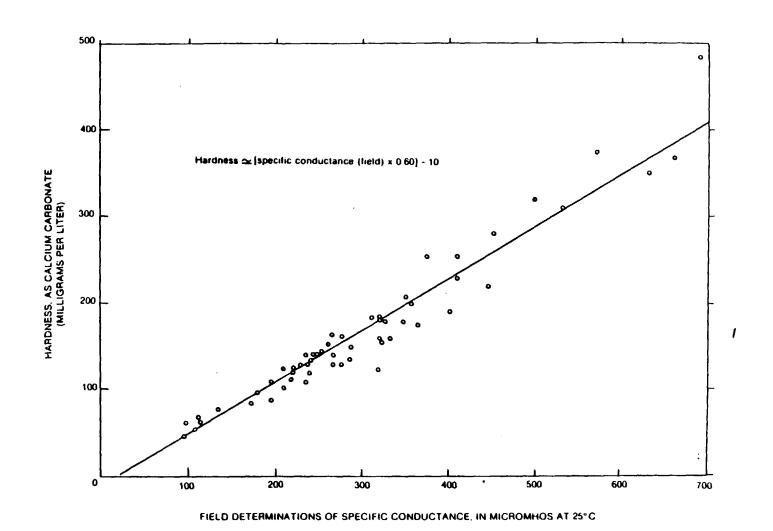


Figure 16.—Relationship of hardness, as calcium carbonate, to specific conductance (field) of water samples from carbonate aquifers in the Birmingham and Cahaba Valleys of Jefferson County.

ADVANTAGES OF USING GROUND WATER

In many situations it is much more advantageous to use ground-water supplies than to develop surface-water supplies. Howard (1974) reported that, on the average, the capital expenditures necessary for the development of a ground-water supply ranged from \$100 to \$300 per gallon per minute. In contrast, such expenditures for impounded surface-water supplies generally ranged from \$1,100 to \$1,500 per gallon per minute. Such cost estimates were based on the assumption that the distribution-system costs for either source of water were approximately equal. Treatment costs for surface water generally ranged from 10 to 15 cents per 1,000 gallons of water. In contrast, costs of ground-water treatment averaged from 3 to 5 cents per 1,000 gallons (Howard, 1974).

A summary of the relative advantages and disadvantages of developing ground-water and surface-water supplies was prepared by Becher in 1970 for conditions prevailing in Pennsylvania. It is presented without modification below as table 7. For ground water, the listed disadvantages of small to moderate yields may not apply to certain aquifers within the Birmingham and Cahaba Valleys of Jefferson County. The data collected as a part of this investigation indicate that substantial quantities of ground water can probably be developed from aquifers within these areas.

Data provided by Mr. Fred Scott of the Leeds Water Board show how economical ground water can be locally. Leeds obtains its municipal water supply from three springs and one well. According to Mr. Scott, the electrical costs of pumping water from the springs ranges from 0.0303 to 0.0461 cents per 1,000 gallons. The cost of pumping water from the well which produces approximately 1,000 gpm from the Fort Payne Chert is 0.0573 cents per 1,000 gallons. The only treatment necessary for these ground-water supplies is chlorination, and Mr. Scott said that 5 to 10 pounds of chlorine are required each day depending upon the quantity of water produced. The costs of chlorination were considered "negligible" by Mr. Scott. Generally, chlorination and pH adjustment cost no more than 5 cents per 1,000 gallons of water. Such data show the economic advantages of a ground-water supply once a good source is located. The cost of wells and associated treatment and collection works for supplies of as much as 10 mgd is generally substantially less than the cost of works for the collection and treatment of similar quantities of surface water. Where much larger quantities of water are required, the economic advantage becomes less clear and surface sources may be the best recourse.

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	Table 7.—Relative advantages and dissupplies (from	isadvantages of ground-wa n Becher, 1970, p. 15-16)
use		itream Water
lies.	Advantages	Disadva
ıres	Predictable yield	Requires expensive tre
rom	High yield	Susceptible to drough
₃ for	Easily Accessible	Large evaporation los
0 to	Í	Highly variable supply
		Variable chemical qua
the	4	Susceptible to chemic
∍ of		radioactive contami
ater		Variable sediment con
r. In		Variable temperature
∍nts	Impounded Stream Water	
	Advantages	Disadva
; of	Predictable yield	High development cos
yd t	High yield	Requires expensive tr
t is	Easily accessible	Silting rate limits usef
the	Large supply	Floods land areas
√ to	Large storage capacity	Large evaporation los
of	Multi-purpose use	Variable chemical qua
		Susceptible to chemic
:ion	·	radioactive contami Variable temperature
[,] be		Moderately susceptible
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10W		Ground Water
its	Advantages	Disadva di Misa di Assassa di
g to	Low development costs	Yield difficult to predi
าgs	Low treatment costs	Small to moderate yie
: of	Low cost of expanding yield Constant supply	Moderate supply Moderately susceptible
000	Relatively constant yield	nearby sewage and
⁻he	Constant chemical quality	disposal
is	Constant low temperature	G.0 p 00 u .
are	Sediment-free supply	
	Relatively immune to drought	
ed.	No evaporation losses	
ott.	Development uses small land are	a
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It is estimated that, in 1977, a good test-drilling program designed to locate a well capable of producing 0.5 to 1 mgd from one of the better aquifers in the study areas would cost about \$25,000. This would include the drilling of 5 or 6 test wells and aquifer tests necessary to establish the optimum production rate for a successful well. In 1977 dollars, the capital outlay needed for producing 0.5 to 1 mgd of ground water from a well at a proven site would be about \$85,000. This would include the costs of the well, the pump, the 72-hour aquifer test, the building, and the equipment necessary to chlorinate and adjust the pH of the water (if necessary). Based on the above cost estimates, approximately \$100,000 would be necessary to locate and construct a well capable of producing between 0.5 and 1 mgd from one of the better aquifers in the Birmingham or Cahaba Valleys of Jefferson County.

GROUND-WATER MANAGEMENT

Orderly planning and development are essential for the utilization of ground-water resources on a large scale. Sound management based upon such planning can prevent over-development of the resource in any particular area and should lead to the long-term availability of good-quality ground water. In Jefferson County, unwise ground-water development could result in major problems of subsidence, reduced streamflow, and induced contamination.

Excessive ground-water withdrawals from an aquifer within a limited drainage basin could cause local streamflow to decrease. The resulting decreased streamflow could become a serious problem if the stream were receiving chemical and/or organic waste loads already equal to its capacity for assimilation. In addition, the aquifer could be contaminated through induced recharge from the stream to the aquifer. Management of water resources to prevent contamination of an aquifer is quite important. Once an aquifer is contaminated, it may take many years for the pollutant to be diluted and flushed out because ground water generally flows very slowly.

Subsidence is a problem common to areas underlain by limestone and dolomite formations, and such problems have occurred in Jefferson County. Generally, subsidence occurs as a result of significant declines in the water table after large quantities of ground water are withdrawn. Reduced recharge can also cause the water table to decline. Therefore, it is important that the recharge area of a productive aquifer be protected from excessive development. Large buildings and parking lots can greatly reduce the effective recharge

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area of an aquifer, and their effects upon the water resources of the region should be one of the factors considered in the design and/or approval of such works.

The proper development of a ground-water reservoir in Jefferson County, or any other area, requires a knowledge of the amount of ground water that can be removed from each aguifer without unbalancing the overall hydrologic equilibrium. The geologic and hydraulic framework must be interpreted and utilized with a philosophy of developing the maximum "safe yield". Something akin to safe yield is referred to as the "Safe benefit to the user" (Todd, 1959, p. 200). Both terms refer to the maximum amount of water that can be removed from the aquifer indefinitely without producing an undesirable result. The undesirable result commonly means that the quantity or quality of the supply is reduced. Users of the resource must not be almowed to withdraw unlimited quantities of water from the aguifer. Unrestricted and unplanned use tends to be destructive of the resource and is not, therefore, in the best interest of all users or in the public interest. Such use can only lessen the future usefulness and value of the ground-water resource.

Currently, the safe yield of aquifers within the study areas cannot be determined because of insufficient data. However, data collected during this investigation will be useful in future determinations of safe yield, and they show that large quantities of ground water of good quality are probably available in the Birmingham and Cahaba Valleys. This resource could be very valuable in the future development of Jefferson County if wisely managed.

SUMMARY AND CONCLUSIONS

The data collected during this investigation indicate that the ground-water resources of the Birmingham and Cahaba Valleys are currently being used only to a limited degree. Homeowners use it as a domestic supply and industry utilizes it to some extent in manufacturing, in ore extraction, and in heating and cooling. Ground water from wells or springs supplies several public water-supply systems. Data collected during this investigation show that several wells in the study areas are capable of producing more than 1 million gallons of water per day.

Several springs discharging large quantities of water were located during the investigation. A few of them are used as water supplies, but most of them apparently flow unused into storm drains or streams. Collectively, the flow from these springs represents a substantial

quantity of unused water. Methods of utilizing these unused discharges should be investigated.

Reported domestic-well yields in the study areas ranged from 2 to 22 gpm and had a median of 7 gpm. Reported municipal and industrial well yields for the aquifers ranged from 50 to 1,200 gpm. Specificcapacity values for all wells ranged from 0.1 gpm/ft to 65 gpm/ft. The Fort Payne Chert-Tuscumbia Limestone and the Bangor Limestone aquifers had the highest specific capacities. Significant spring discharges from these aquifers ranged from 30 to 3,900 gpm during the spring of 1977.

The total of the ground-water withdrawal rates from 19 large wells within the Birmingham and Cahaba Valleys was approximately 9,000 gpm. This would be equivalent to about 13 million gallons of water per day if all these wells were operated 24 hours a day. Some of them were not. The total of the maximum estimated or reported discharges of fifteen springs was about 20,400 gpm (or about 29 mgd). The total of the minimum estimated or reported flows of the same springs was about 11,000 gpm (or about 16 mgd). It should be noted, however, that the lowest recorded rate of discharge from most of these springs was obtained in June 1977 whereas the normal annual low usually occurs in October or November. The large yields of municipal and industrial wells and of springs in the areas indicate the probable availability of sizeable quantities of additional ground water.

All the aquifers in the study areas appear to have good potential as sources of ground water. The Fort Payne Chert-Tuscumbia Limestone aquifer is probably best suited for development because its geologic properties greatly increase the likelihood of obtaining a successful well throughout the Birmingham and Cahaba Valleys. This aquifer currently sustains several large production wells within the study area. The exploration and development costs necessary to establish production wells in this aquifer would probably be less than for any of the other aquifers. Furthermore, this aquifer is confined between two formations that form barriers against contamination and subsidence. Artesian conditions within the aquifer might reduce pumping costs by reducing the distance which the water must be lifted.

The results of chemical analyses of water samples indicate that, for the parameters analyzed, no significant inorganic chemical contamination is present in the aquifers of the Birmingham and Cahaba Valleys of Jefferson County. Iron was the only constituent whose concentration exceeded recommended drinking-water standards. However, only 14 percent of the water samples had iron contents greater than the recommended limit of 0.3 mg/l. Nitrate concentrations were higher than normal but background values did

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not exceed the drinking-water limits. Some users might object to the water's hardness. Treatment and/or dilution with water from other sources, if available, might be used to reduce the high iron content and hardness to acceptable levels. The results of the analyses indicate that the ground waters in the study areas are suitable for most industrial. municipal, and domestic uses.

The data collected on current major ground-water withdrawals and discharges in the Birmingham and Cahaba Valleys indicate that ground water could play a significant role in the future development of Jefferson County. The better aquifers are probably capable of producing significant quantities of water in each of the two valleys. The quality of the ground water is good, and the uniform temperature. pH, and chemical characteristics of the ground water as well as natural filtration and protection from contamination make it a valuable source of water.

Data provided by the Leeds Water Board show that the cost of pumping ground water is minimal. Generally, chlorination and pHadjustment costs are also low. The costs of wells and the associated treatment and collection works for supplies of as much as 10 mgd is generally significantly less than those for comparable surface-water supplies.

The general availability of a valuable natural resource can sometimes lead to its over-development. In Jefferson County, unwise ground-water development could result in subsidence, reduced streamflow, and the possibility of induced contamination. It is not in the best interest of the public or of industry to allow unrestricted and unplanned use of such a valuable resource as the ground waters of the Birmingham and Cahaba Valleys.

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figure indicates a daily flow of about 16 million gallons. The total discharge of the highest estimated or reported discharges minus the quantities consumed is 20,400 gpm. This figure is equivalent to about 29 mgd.

The above estimates indicate that Jefferson County could obtain significant quantities of readily available water from springs. Of course, each spring would have to be evaluated with consideration for all appropriate methods of use. For instance, the spring owned by Republic Steel Company is an example of the need for careful planning before the development of a spring. The spring had estimated flows of 3,000 and 2,000 gpm on March 25 and June 6, 1977, respectively. These rates of flow are equivalent to 4.3 and 2.9 mgd, respectively. The total yield of the spring probably could not be diverted for use elsewhere because its flow may be needed to maintain a small stream that flows into Tannehill State Park, an important recreational facility. Thus, a study would be warranted to determine if a part of the flow could be used elsewhere without impairing the recreational value of the park.

Glenn Spring and the spring at the Alabama Boys' Industrial School had estimated flows of 500 and 2,000 gpm on June 6 and 7, 1977, respectively. Both springs could be developed as supplies of large quantities of water. However, a rare species of fish (the Watercress darter) lives in these springs (Howell and Black, 1976; H. T. Boschung, 1977, personal communication). Therefore, great care would be required in the use of these supplies. Development of the water supply from these springs might be possible by withdrawing the water a sufficient distance downstream from the fish's habitat.

Several other springs having substantial discharges could probably be utilized. These are Penny Spring, Killough Spring, spring L-19, Avondale Spring, Caldwell Spring, Moore's Spring, Tarrant Spring, and Hawkin's Spring. Twelve measured and three estimated flows for Penny Spring had a range of 1,360 to 3,880 gpm. The average flow, based on the twelve measured values, is approximately 2,500 gpm or the equivalent of more than 3.6 mgd. The minimum observed flow is equivalent to about 2 mgd. Penny Spring currently flows into a nearby stream. Killough Springs, with several discharge points, was releasing an estimated 1,720 gpm or almost 2.5 mgd into a nearby stream on June 7, 1977. Spring L-19 was discharging an estimated 1,150 gpm or 1.6 mgd through a lake on June 7, 1977. The discharge for Spring L-19 was estimated where the water flowed out of the lake, and it could not be determined whether there was only one spring or multiple sources filling the lake. Avondale Spring, which flows through Avondale Park and subsequently into what is apparently a storm drain.

GEOLOGICAL SURVEY OF ALABAMA

WALTER S. JONES, PH.D., STATE GEOLOGIST

SPECIAL REPORT NO. 16

GROUND WATER IN THE PALEOZOIC ROCKS OF NORTHERN ALABAMA

BY

WILLIAM DRUMM JOHNSTON, JR.

WITH ANALYSES BY MARGARET D. FOSTER AND C. S. HOWARD

PREPARED IN CO-OPERATION WITH THE UNITED STATES
GEOLOGICAL SURVEY

PART I.-TEXT



UNIVERSITY. ALABAMA 1933 "These rivers have cut valleys about 200 feet below the general surface. Portions of the valleys of High Pine Creek in Alabama and Town Creek in Georgia, which are minor streams, lie along the border of the Archean rocks between Tallapoosa and Chattahoochee rivers.

"There are no striking topographic features in the Opelika Plateau. Away from the breaks near the river this plateau has a gently diversified surface that is largely cultivated. The equivalent of the Opelika Plateau in Georgia is the Greenville Plateau, which is more diversified."

THE VALLEY AND RIDGE PROVINCE

The Valley and Ridge province in Alabama is marked by northeastward-striking valleys and ridges developed upon the sandstone, shale, limestone, and dolomite of Paleozoic age. Over much of this province the Cumberland peneplain has been destroyed and the land surface is a result of later erosion cycles.

In Alabama the adjoining provinces are higher and are bounded by outward-facing escarpments; hence this province is often called the Appalachian Valley.

WEISNER RIDGES

The Weisner Ridges in Calhoun, Cherokee, and Cleburne counties, are a series of maturely dissected monoclinal mountains of strong relief. They are developed upon the resistant Weisner quartzite and rise to a maximum altitude in Dugger Mountain of 2,130 feet, approximately 1,200 feet above the average altitude of the land surface to the west. They extend from the Indian Mountains, on the Georgia line, southwestward for 40 miles to Coldwater Mountain, south of Anniston. The ridges are separated from the mountainous country of the inner edge of the Piedmont Upland by Choccolocco Valley, whose floor ranges between 600 and 700 feet in altitude. Nance's Creek occupies a narrow valley between Choccolocco and Dugger mountains, and the city of Anniston occupies a trasverse synclinal valley between the south end of Choccolocco Mountain and Coldwater Mountain. Complex faulting repeats parts of the Weisner quartzite section and has caused the discontinuity of the ridge.

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¹ LaForge, Laurence, Georgia Geol. Survey Bull. 42, pp. 77-78, 1925.

¹ McCalley, Henry,

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AREAL DISTRIBUTION, LITHOLOGIC CHARACTER, AND WATER-BEARING PROPERTIES OF THE DIFFERENT FORMATIONS

In the following pages the rock formations are described in ascending order, and the water-bearing character and the quality of the water yielded by each formation is briefly summarized. More detailed local discussion of the water-bearing properties of the formations and analyses of the waters are contained in the county descriptions.

The formational descriptions are taken largely from Butts's chapters on the Paleozoic rocks.¹ The geologic map accompanying his report can advantageously be referred to in reading the following pages.

ALGONKIAN (?) AND PALEOZOIC ROCKS

Talladega Slate

General Features.—The Talladega slate occupies a belt 6 to 20 miles wide extending from Cleburne County southwest to Chilton County. Butts' describes the formation as follows:

"Much the greater part of the Talladega mass, which possibly aggregates a thickness of 30,000 feet, consists either of slate or sericitic phyllite, a metamorphic rock intermediate between slate and schist. Interbedded in the phyllite, as minor constituents of the mass, are beds of conglomerate, sandstone, limestone, marble, dolomite, chert, graphitic phyllite, and quartz schist. The predominating phyllite of the formation is usually a dark slate-colored or slightly greenish fine-grained rock resembling ordinary roofing slate but very smooth and silky looking upon cleavage surfaces. Where the rock has weathered a long time near the surface of the ground it becomes grayish, pale ocherous, or splotched with pale-pink tints. On extreme weathering, the phyllite is commonly reduced to a condition resembling a semi-hardened, laminated gray or light-brown clay. This type of rock is made up generally of sericite in fine flakes and shreds, finely divided quartz, and a small quantity of chlorite. Larsen thus describes typical specimens from thin sections:

Adams, G. I., Butts, Charles, Stephenson, L. W., and Cooke, C. W., Geology of Alabams; A abama Geol. Survey Special Rept. 14, pp. 40-230, 1926.
Butts, Charles, op. cit., p. 50.

"1. Slate, very fine textured rock with slaty clevage due to the parallel arrangement of the minute shreds of sericite, chlorite, kaolinite, and other minerals. There are a very few small grains of quartz.

"'2. Sericitic quartzite. Over half of this specimen consists of minute grains of quartz with a few of feldspar. These grains are embedded in a matrix composed of shreds of sericite, kaolinite, chlorite, etc.—probably derived from a sandy shale.'"

Water-Bearing Capacity.—The Talladega slate is a good aquifer. Water occurs in joints, fissures, and minute cracks parallel with the planes of schistosity and in the open spaces developed near the surface by the weathering of the slate. Most of the wells in this formation are dug and obtain their water from the weathered zone, in which porosity reaches a maximum. Such drilled wells as penetrate joints and fissures in the slate will be successful and the yields will be directly dependent upon the size and continuity of these openings.

Quality.—Two samples of water obtained from this formation were of good quality. They contained less than 100 parts per million of dissolved mineral matter, principally calcium bicarbonate. (See Talladega County, Nos. 37 and 55.)

SYLACAUGA MARBLE MEMBER OF THE TALLADEGA SLATE

General Features.—The Sylacauga marble member of the Talladega slate crops out in a narrow band appearing 4 miles southeast of Talladega and extending for 30 miles to the south and west into Coosa County. Much of the marble is white to cream colored and is translucent. Certain beds contain inclusions of green phyllite. The following analyses are given by Prouty:

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¹ Prouty, W. F., Preliminary report on the crystalline marbles of Alabama: Alabama Geol. Survey Bull. 18, pp. 24 and 97, 1916.

Analyses of the Sylacauga marble

	1	2	3
Iron and aluminum oxides			
Siliea (SiO ₂)	0.29	3.16	0.33
(Fe ₂ O ₂ andAl ₂ O ₂)	10	.47	.05
Magnesia (MgO)		3.53	.36
Lime (CaO)		49.75	55.13
Carbon dioxide (CO _z)	43.91	42.77	43.32
	100.20	99.68	99.19

^{1.} Average analyses of two samples of white marble from Gantt's quarry.

2. Marble from Van Deusen Spring, near Sylacauga.

Between Sylacauga and the Coosa County line the marble is bordered on the east by calcareous rocks of Cambrian and Ordovician age which include dolomite beds.

Water-Bearing Capacity.—The marble furnishes a number of springs in Talladega County, some with yields of 100 gallons or more a minute. These are fed by water contained in interconnected solution channels within the formation, such as are described on pages 35-37.

Drilled wells are successful if they penetrate these solution channels, and their yields are dependent upon the rate of recharge of the channels encountered. Unless an adequate water supply is obtained in the first 200 feet a drilled well should be relocated. The futility of deep drilling in calcareous rocks is illustrated by the Sylacauga city wells, discussed on page 324.

Dug wells obtain water from the clayey subsoil derived from the weathering of the marble. Such wells in favorable topographic situations are usually satisfactory for domestic use.

Quality.—This formation yields characteristic limestone waters. The three samples analyzed were similar in mineral content ranging from 150 to 170 parts per million of total dissolved solids, which consisted principally of calcium bicarbonate. As is to be expected from the chemical character of the marble, the magnesium content of the waters is low. (See Talladega County, Nos. 30, 49, and 50; also fig. 43.)

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^{3.} Marble from Madras Marble Co., sec. 36, T. 21 S., R. 3 E.

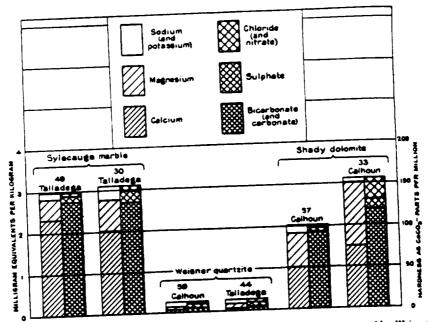


Fig. 43.—Graphic representation of analyses of waters from the Sylacauga marble, Weisner quartsite, and shady dolomita.

PALEOZOIC ROCKS

CAMBRIAN SYSTEM

WEISNER QUARTZITE

General Feature.—The Weisner quartzite is exposed in Indian, Choccolocco, and Coldwater mountains, Calhoun and Cherokee counties; in the Talladega Hills, Talladega County; and in Columbiana Mountain, Shelby County. In addition there are a number of outliers such as Mount Weisner and Katala and Kahatchee mountains. Because of its hardness and resistance to erosion the quartzite is a mountain-making formation, and its principal outcrop in the Weisner Ridges forms a distinctive physiographic unit in Alabama.

The formation is composed of sandstone, ranging from quartzite to soft and poorly cemented beds, conglomerate, and shale. In places it is slightly metamorphosed. In thickness it ranges from 1,700 feet to a probable maximum of 5,500 feet.

Water-Bearing Capacity.—The more poorly cemented sandstones and conglomerates of the Weisner are water-bearing, but in the shales and quartzitic beds water occurs only in joints and fractures ing large niston, w a second. County.

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fractures. Such fractures, however, may be capable of furnishing large amounts of water, as at Coldwater Spring, south of Anniston, where the badly faulted beds yield 50 cubic feet or more a second. This spring is described in the chapter on Calhoun County.

Several drilled wells have failed to encounter water-bearing cracks in this formation. In 1926 a well on Choccolocco Mountain was drilled to a depth of 305 feet without finding water.

The lower slopes of the Weisner outcrops are covered to a depth of several feet by porous clayey sand derived from the weathering of the harder rocks. This subsoil layer is water-bearing and supplies dug wells and springs.

Quality.—Water from this formation is of excellent quality. The most highly mineralized of the five samples analyzed contained only 78 parts per million of total dissolved solids. (See Calhoun County. Nos. 49, 58, and 59, and Talladega County, Nos. 12 and 44.) The exceptionally low mineral content of the Weisner water is shown in Figure 43, where it is compared with water from the underlying Sylacauga marble and overlying Shady dolomite.

SHADY DOLOMITE

General Features.—The Shady dolomite crops out over small areas in the valleys of the Weisner Ridge district in Calhoun and Cherokee counties and along the eastern slope of the Talladega Hills, Talladega County. It is composed of thick regular beds of gray dolomite and limestone, which weather to a reddish and in places limonitic soil. Its thickness ranges from 500 to 1,200 feet. It occurs in valleys at the foot of dip slopes developed upon the Weisner quartzite.

Water-Bearing Capacity.—The Shady dolomite is a good aquifer, and its water-bearing capacity is characteristic of the calcareous rock in northern Alabama. Channels produced by the enlargement of joints form an interconnected cavern system, through which the ground water moves, and the success of drilled wells is dependent upon the size and capacity of the cavities encountered. Dug wells usually end in the subsoil that caps the unweathered rock. Although this subsoil is clayey and has a low permeability it permits the passage into the well of sufficient quantities of water for average domestic needs.

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A number of springs in Calhoun and Cherokee counties are fed by the Shady dolomite, and some water issuing from Coldwater Spring, south of Anniston, has doubtless passed through the formation.

Quality.—This formation yields water which is typically dolomitic in character. The mineral content is variable. Samples from two springs contained 105 and 109 parts per million of total dissolved solids. A well water, while of the same dolomitic type as the spring waters, was more highly mineralized, containing 203 parts per million of total solids. The chloride and sulphate content of the two spring waters was much lower than that of the well water. (See Calhoun County, Nos. 33, 57, and 68; also fig. 43.)

ROME FORMATION

General Features.—There is a long, narrow strip of the Rome formation on the eastern margin of the Cahaba Valley; a crescent-shaped outcrop south of Columbiana Mountain, Shelby County; three northeastward elongated areas in Talladega County; and several outcrops surrounding the Weisner Ridges in Calhoun and Cherokee counties. The formation is composed of red and green shale, light-gray and rusty to chocolate-colored sandstone, and locally a few beds of bluish limestone and a little dolomite. The red shale and the rusty calcareous sandstone make up the bulk of the formation and conspicuously mark its outcrop.

Water-Bearing Capacity.—The Rome formation is generally a poor aquifer, as the red shale that constitutes a great part of the formation is water-bearing only where exposure to weathering has opened the laminae of the shale and produced secondary porosity. Upon such weathered outcrops dug wells are fairly successful. Some of the sandstone beds are porous and would doubtless yield water, but no wells in which the water was furnished by these beds were observed. A few springs are fed by water contained in the upper weathered shale. Four-mile Spring, in Calhoun County, is fed by water issuing from a thin limestone bed contained in the shale. In October, 1928, it flowed approximately 100 gallons a minute, which is unusual for this formation.

Quality.—As is shown in Figure 44, the waters from the Rome formation are extremely variable in quality. Five analyses of waters from this formation range from 15 to 372 parts per million of total dissolved solids. Four of the waters are of the calcium bicarbonate type and one is a sodium bicarbonate water.

MILLIGRAM EQUIVALENTS PER KILOGRAM

Fig. 44.-(

WATER-BEARING FORMATIONS

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Magnesium

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Fig. 44.—Graphic representation of analyses of waters from the Rome and Conssauga formations.

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The most concentrated of the waters of the calcium bicarbonate type is also high in sulphate. A sixth analyses—that of Garvey Spring, in Bibb County—is very highly mineralized, containing 2,122 parts per million of dissolved mineral matter principally calcium sulphate. Such waters as this are not suited for domestic use. They are used locally to some extent for medicinal purposes. (See Bibb County, Nos. 17, 26, and 54; Calhoun County, Nos. 24 and 56; and Shelby County, No. 14.)

CONASAUGA FORMATION

General Features.—The largest area underlain by the Conasauga formation is in the north half of the Coosa Valley, where the outcrop attains a maximum width of 15 miles. This area extends to the south and east into the Big Canoe and Cahaba valleys, St. Clair County. Other outcrops are in the Jones and Oppossum valleys, within the larger Birmingham Valley; at the south end of the Cahaba Valley; at the foot of Columbiana Mountain; on the east side of the Rome formation outcrops in Talladega County; and in the valleys surrounding the Weisner Ridges in Calhoun and Cherokee counties.

The Conasauga formation is composed of limestone, dolomite, and shale in varying proportions. In the Birmingham and Cahaba valleys it is a medium to thick bedded dark blue limestone interbedded with shale and locally with dolomite. In the northeastern part of the State, in St. Clair, Etowah, Calhoun and Cherokee counties, it is dominantly shaly, but it contains thin limestone beds. This shaly phase is expressed topographically in the "Flatwoods" of the Coosa Valley.

The following is an average of two analyses of magnesiumbearing limestone from an old quarry near Wheeling, northwest of Bessemer, Jefferson County:

ANALYSIS OF CONASAUGA LIMESTONE

(WILLIAM E. JONES, ANALYST)

Silica (SiO ₂)	. 1.20
Iron and aluminum oxides (Fe ₂ O ₃ +Al ₂ O ₃)	
Calcium carbonate (CaCO ₂)	
Magnesium carbonate (MgCO ₂)	
Sulphur dioxide (SO ₂)	115
•	98,875

¹ U. S. Geol. Survey Bull. 400, p. 198, 1910.

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Water-Bearing Capacity.—The Conasauga limestones of the Birmingham Valley are good aquifers. The beds dip steeply and contain well-developed solution channels which are capable of yielding large quantities of water. These limestones underlie a part of the city of Birmingham and supply drilled wells. South of Birmingham are a number of large springs fed by the limestones. Hawkins Spring, which is of particular interest, is described on pages 235-236.

In the Coosa Valley, where the formation is dominantly shaly, it is not a good aquifer. The unweathered rock is impermeable, and its underground circulation is confined to the thin interbedded limestone layers. Weathering, however, gives it some porosity, and many dug wells ending in the shaly subsoil are satisfactory for domestic purposes.

Quality.—As is to be expected from the variable lithologic character there is a wide variation in the mineral content of water from the Conosauga formation. Three waters from the Birmingham and Cahaba valleys ranged from 106 to 256 parts per million of total solids. One was a typical limestone water and the other two were typically dolomitic. As indicated by two analyses the shale waters from the Coosa Valley are harder and more highly mineralized, one containing as much as 641 parts per million of total solids with 115 parts of sulphate. (See Cherokee County, Nos. 22 and 65; Jefferson County, No. 108; St. Clair County, No. 11; and Talladega County, No. 9; also fig. 44.)

CAMBRIAN OR ORDOVICIAN SYSTEM

The thick series of cherty dolomites in Alabama that rest upon the Conasauga formation, of Cambrian age, and are overlain by the Longview limestone, of Ordovician age, have been divided by Butts' into five formations, named, in ascending order, the Brierfield dolomite, Ketona dolomite, Bibb dolomite, Copper Ridge dolomite, and Chepultepec dolomite. They, with the overlying Longview limestone, constituted the Knox dolomite of the older State reports.

These dolomites (Brierfield to Chepultepec inclusive) are equivalent in age to the rocks in Missouri for which Ulrich has proposed the name "Ozarkian system." Pending the completion

¹ Butts, Charles, op. cit., pp. 78-92.

² Ulrich, E. O., Revision of the Paleozoic systems: Geol. Soc. American Bull., vol. 22, pp. 627-647, 1911.

of his studies upon the "Ozarkian" the United States Geological Survey designates the rocks as of Cambrian or Ordovician age.

Analyses of waters from some of these formations are repsented in Figure 45.

BRIERFIELD DOLOMITE

General Features.—In describing the Brierfield dolomite Butts' says:

"The Brierfield dolomite is certainly known only in Cahaba Valley south of the latitude of Maylene, Shelby County. It is most fully exposed on Sixmile Creek in sec. 31, T. 24 N., and sec 6, T. 23 N., R. 11 E. There are also good exposures on Mahan Creek in the vicinity of Brierfield and on Spring Creek in the town of Montevallo.

"The Brierfield is a thick-bedded coarse-grained steely-blue and, in part at least, highly siliceous dolomite. Specimens collected at Brierfield contain 40 per cent silica. The silica accumulates as a fretwork on weathered surfaces or as a cavernous incrustation of considerable depth on residual boulders of the dolomite. These boulders are commonly dolomite inside. They are very distinctive markers for the Brierfield. Boulders of dense chert of smooth and rounded contours are also formed at a horizon rather low in the Brierfield. Another characteristic of the Brierfield is the cavernous or pitted surface of the well-weathered layers in some parts at least of the formation, a feature well displayed along Spring Creek in the town of Montevallo.

"The thickness of the Brierfield on Sixmile Creek, where the conditions for measuring are favorable, is about 1,500 feet."

Water-Bearing Capacity.—The Brierfield dolomite is typical of the calcareous rocks in northern Alabama. The bedded strata below the soil zone are cut by solution channels formed by the enlargement of joints and fissures through which the ground water circulates and from which it issues in springs. On the southern edge of the town of Montevallo is Shoal Creek Spring, on the Brierfield outcrop, which furnishes the public water supply. This spring yields approximately 250 gallons a minute.

¹ Butte, Charles, op. cit., p. 81.

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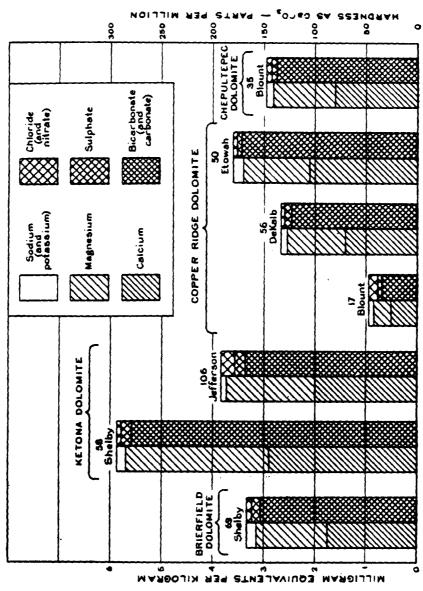
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dolomite, Copper Ridge dolomite, and Chepulte Fig. 45.-Graphic representation of analyses of waters from the Brierfield dolomita, Kentone

Dug wells obtain their water from the cherty, somewhat porous subsoil formed by the weathering of the dolomite. They are usually satisfactory throughout the year and furnish abundant water for domestic use.

Quality.—A single analysis of Brierfield dolomite water was made, from the Shoal Creek Spring, at Montevallo. The water contains 153 parts per million of total solids, and is a typical dolomite water. (See Shelby County, No. 69; also fig. 44.)

KETONA DOLOMITE

General Features.—The Ketona dolomite outcrops in the Birmingham and Cahaba valleys and the southern part of Murphree's Valley. The largest area of exposure is in the vicinity of Birmingham. North of the city it is quarried for flux and for concrete aggregate. Butts' says:

"The Ketona is a coarsely crystalline light-gray thick-bedded dolomite that is a remarkably pure carbonate of magnesium and calcium. The ratio of calcium carbonate to magnesium carbonate is very close to that of the theoretic dolomite. The most distinctive feature of the Ketona is its purity and freedom from chert or siliceous residual material of any kind. Thick parts of the formation as disclosed in quarrying operations average less than 2 per cent of insoluble impurities, silica, and alumina. * * * In this particular the Ketona is in remarkable contrast with all the other dolomite formations of the region, which are highly siliceous and yield much chert or siliceous residue upon weathering. * *

"In Birmingham Valley the thickness of the Ketona appears to be 400 to 600 feet.

"The Ketona is of great economic value as a fluxing material for use in smelting the iron ores of the region. Large quarries are operated for rock for this purpose at Thomas, Ketona, and Dolcito, in the vicinity of Birmingham."

The following analyses are typical:

Butts, Charles, op. cit., pp. 82-83.

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1age 38, ANALYSES OF THE KETONA DOLOMITE(1)

	1	2	3
Silica (SiO ₂)	1.31	0.70	3.53
Pyrite (FeS ₁)			.15
Alumina (A1,O1)		.63	
Calcium carbonate (CaCO ₂)	55.80	56.41	52.11
Magnesium carbonate (MgCO ₂)	42.47	43.00	44.94
Calcium sulphate (CaSO.)			.87
-			
1	100.54	100.74	101.60

- 1. Average of four analyses of average samples from Ketona quarry from August to October, 1903. Tennessee Coal, Iron & Railroad Co.
- 2. Average of ten analyses of carload lots from North Birmingham quarry from August, 1903, to June, 1905. Sloss-Sheffield Steel & Iron Co.
- 3. Sample of powdered rock from storage bin, Dolcito quarry, 1929. Margaret D. Foster, analyst,

Water-Bearing Capacity.—The Ketona dolomite is a good aquifer. The Dolcito quarry, at Tarrant City, north of Birmingham, has intercepted a number of solution channels, and the water that formerly flowed through them collects on the quarry floor. Approximately 750,000 gallons of water is pumped out of the quarry each day. Solution channels in the walls of the North Birmingham quarry of the Sloss-Sheffield Steel & Iron Co. yield an average of 2,736,000 gallons a day, and a maximum of 6,192,-000 gallons was recorded.

Several drilled wells in Birmingham end in the Ketona dolomite. Most of them are pumped at the rate of 100 gallons or more a minute, but a few failed to encounter solution channels of adequate capacity and were filled and abandoned. Springs in the Birmingham Valley fed by this formation are described in the chapter on Jefferson County.

Quality.—The Ketona waters are dolomitic in character and their mineral content is unusually uniform. Three samples that were analyzed contained 203, 204, and 285 parts per million of total dissolved solids. The sulphate in the samples—10 to 20 parts per million—may be derived from the small amount of pyrite that occurs within the dolomite. (See Jefferson County, Nos. 104 and 106; and Shelby County, No. 58; also fig. 43.)

¹ Butts, Charles, U. S. Geol. Survey Geol. Atlas, Birmingham folio (No. 175), p. 22, 1910.

Personal communication from Mr. H. J. Thomas.

BIBB DOLOMITE

General Features.—The exposure of the Bibb dolomite is confined to a relatively small area at the south end of the Cahaba Valley, in Bibb County and southern Shelby County, near the inner edge of the Coastal Plain. Lithologically the Bibb so closely resembles the Brierfield that were it not for the intervening Ketona dolomite it would not be recognized as a distinct formation. Like the Brierfield, it is thick-bedded, dark, coarsely crystalline, and highly siliceous, and it yields boulders that are thickly incrusted with drusy, cavernous quartz. Locally many of these boulders are deeply pitted. Butts gives 250 to 500 feet as the thickness of the formation.

Water-Bearing Capacity.—Like the other Cambrian or Ordovician dolomites the Bibb dolomite is a good aquifer, yielding water to drilled wells that encounter solution channels and forming a porous subsoil from which suitably located shallow dug wells obtain their supplies. Water issues from several springs within the outcrop area.

Quality.—A single, partial analysis of Bibb dolomite water was made. It shows a calcium and magnesium bicarbonate water containing 158 parts per million of total solids and is probably representative of waters from this formation. (See Bibb County, No. 56.)

COPPER RIDGE DOLOMITE

General Features.—The Copper Ridge dolomite crops out over large areas in Birmingham Valley and forms chert ridges in the Cahaba and Murphree valleys. It occurs in the Broomtown Valley, north of the Coosa River in Cherokee County, and in the lower Coosa Valley, in Calhoun and Talladega counties. The formation is composed of thick-bedded light to medium gray coarsely crystalline dolomite. Upon weathering of the beds much secondary chert is developed. Butts' says:

"The chert of the Copper Ridge dolomite is distinctive. It is compact, dense, tough, and hard, generally white or yellowish gray, and pieces of whatever size are usually jagged on the surface. It breaks up along joint fracture planes but does not abrade by transportation nor take on

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¹ Butts, Charles, op. cit., pp. 85-86.

smooth or rounded forms by ordinary weathering. Chert gravel along stream beds is sharply angular whatever its size. * * *

"C. W. Washburne found by microscopic examination of thin sections that the chert is completely crystalline and is an aggregate of quartz crystals, the smallest of which are visible under low powers of the microscope.

"The thickness of the Copper Ridge dolomite is about 1,800 feet on Alligator Creek, the only place where an approximately reliable measurement can be made. It has usually been estimated as 2,000 feet thick in the Birmingham district and probably reaches that or a greater thickness in the great area in Talladega and Calhoun counties."

Water-Bearing Capacity.—The Copper Ridge dolomite is an excellent aquifer throughout its outcrop. Usually there is developed in it elaborate system of closely spaced and interconnected solution channels, which supply drilled wells and springs. Weathering results in much secondary chert, which collects in the subsoil, forming a more or less permeable and in places spongy ground-water reservoir, which supplies many hundreds of dug wells located upon the Copper Ridge outcrop.

Quality.—This formation yields waters of uniform mineral content. Out of 14 analyses of Copper Ridge waters 12 range from 110 to 176 parts per million of total dissolved solids. Although most of these waters are dolomitic in character, a few are low in magnesium and show a gradation toward limestone waters. They are all very low in sodium sulphate, and chloride. One sample which is very low in mineral content, having only 49 parts per million of total solids, came from a well in puturned chert beds from which much of the carbonate has been leached. It is probable that circulation in this formation is fairly rapid and descending ground water is not long in contact with fresh dolomite. (See Bibb County, No. 47; Blount County, No. 17; Calhoun County, Nos. 50 and 60; Cherokee County, No. 67; De-Kalb County, No. 56; Etowah County, Nos. 50, 54, and 55; Jefferson County, No. 48; St. Clair County, Nos. 51 and 57; Talladega County, No. 2; and Tuscaloosa County, Nos. 68 and 69; also fig. 45.)

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CHEPULTEPEC DOLOMITE

General Features.—The Chepultepec dolomite occurs in the Sequatchie, Big Wills, Murphree's, and Cahaba valleys, in the lower part of the Coosa Valley in Calhoun and Talladega counties, and south of Wilsonville and east of Shelby in Shelby County. The formation is a thick to medium bedded light-gray fossoliferous dolomite, with a maximum thickness, according to Butts, of 1,100 feet. The lower third of the formation on Alligator Creek, southwest of Montevallo, is limestone. Butts describes the chert yielded by the Chepultepec as "a peculiar soft, mealy cavernous chert, which looks like a piece of worm-eaten wood." This type is common in the Chepultepec and serves to distinguish it, just as the jagged chert boulders serve to identify the Copper Ridge dolomite and the quartz druses serve to identify the Bibb and Brierfield dolomites.

Water-Bearing Capacity.—In its water-bearing character the Chepultepec dolomite is similar to the underlying Copper Ridge dolomite. Solution channels are abundant and furnish water to drilled wells and to springs. Dug wells end in the permeable cherty subsoil, which is derived from the bedded dolomite by weathering. Such wells, in favorable topographic situations, are reliable sources of domestic water supplies.

Quality.—Three waters from this formation that were analyzed were typically dolomitic in character. The total dissolved solids ranged from 123 to 227 parts per million. (See Blount County, Nos. 32 and 35, and Jackson County, No. 33; also fig. 45.)

ORDOVICIAN SYSTEM

LONGVIEW LIMESTONE

General Features.—The Longview limestone rests upon the Chepultepec dolomite in the Sequatchie and Cahaba valleys and possibly in the lower part of the Coosa Valley. Its thickness is about 500 feet. The formation is mostly thick-bedded light gray cherty limestone but includes some dolomite. Concerning the chert Butts' says:

"The chert of the Longview is compact but brittle and fragile, so that most of it readily weathers down to small

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¹ Butta, Charles, op. cit., p. 93.

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fragments. The larger chunks have generally a smooth, even surface. Through its chert the Longview can be distinguished from the overlying Newala limestone, which yields no chert or very little; from the underlying Chepultepec dolomite, which is characterized by mealy, cavernous chert, as described above; and from the Copper Ridge dolomite, which yields a dense, tough, and jagged chert."

Water-Bearing Capacity.—The Longview limestone is abundantly water bearing. Solution channels are well developed in it and supply springs and drilled wells. The subsoil, which is somewhat less cherty and not so permeable as that derived from the underlying dolomites, has sufficient porosity to form an efficient ground-water reservoir, which supplies shallow wells.

Quality.—One partial analysis of water from the Longview limestone (Bibb County, No. 51) showed 196 parts per million of total solids. This is a typical limestone water.

NEWALA LIMESTONE

General Features.—The Newala limestone crops out on the east side of Cahaba Valley throughout its length, in an area northwest of Columbiana Mountain, and possibly in the Big Wills Valley. Butts' describes the formation as follows:

"The Newala is composed of much limestone and proportionately little dolomite. Most of the limestone is thickbedded, compact or noncrystalline or textureless, dark gray, pearly-gray, and bluish gray. The pearl-gray color perhaps predominates and is most characteristic. For such compact limestone Kindle has recently proposed the name vaughanite and identified a specimen of Newala as a typical vaughanite. The dolomite of the formation occurs either as aggregates or separate layers as much as 20 feet or more thick or as interfingerings of dolomite in layers of limestone which produce a mottled rock that characterizes limestone undergoing change to dolomite by replacement processes. * * * The beds of dolomite, on account of their coarse-grained texture. are called sandstone by the quarrymen in the Cahaba Valley. A notable characteristic of the Newala is the general absence or relative scarcity of chert, in which it contrasts very

¹ Butts, Charles, op. cit., pp. 95-97.

strongly with the underlying dolomite formations as well as with the Longview limestone and with the equivalent dolomite facies that constitutes the upper part of the Knox dolomite of Tennessee.

"The compact limestone, or vaughanite, of the Newala is a very pure calcium carbonate. Five general average samples of this type of rock from four quarries in Cahaba Valley, collected and analyzed by Mr. R. S. Hodges, chemist of Alabama Geological Survey, contained respectively 96.10, 96.13, 97.77, 98.56 and 99.13, per cent of calcium carbonate, the balance to make 100 per cent in the first two samples including a little over 3 per cent magnesium carbonate. Two samples of magnesian rock gave the following results:

		Calcium carbonate	Magnesium carbonate
No.	1	77.66	22.01
No.	2	54.64	41.50

"No. 2 contains calcium and magnesium carbonates very nearly in the dolomite ratio, viz, CaCO₂ 54.35 per cent and MgCO₂ 45.65 per cent.

"The abundance and great purity of most of the Newala gives it great economic value for some purposes, such as making lime, but the occurrence of the dolomite layers detracts much from its value where a pure calcium carbonate rock in large quantities is required, as in certain metallurgic processes, for owing to the distribution of the magnesian or dolomite layers throughout the body of the Newala, a sufficient thickness of pure limestone for the most economical quarrying apparently has not been found, and it is impractical to separate out the magnesian rock.

"The Newala is about 1,000 feet thick in Cahaba Valley, where conditions for measuring are the most favorable."

Water-Bearing Capacity.—Like most of the other Ordovician limestones the Newala is a good aquifer, furnishing water to drilled wells that penetrate its joints and solution cavities and supplying a number of springs. The subsoil derived from this formation is composed largely of clay with limestone fragments and is free from chert. In consequence its permeability is somewhat low, and dug wells, though usually satisfactory, require

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Quality.—The one sample of Newala water which was analyzed (No. 16, Shelby County) contained 294 parts per million of total solids. It was a typical limestone water with a high calcium and low magnesium content. The calcium and magnesium ratio of waters from this formation should vary widely, depending upon the presence or absence of dolomite, but all the waters should be of the calcium and magnesium bicarbonate type. (See fig. 46).

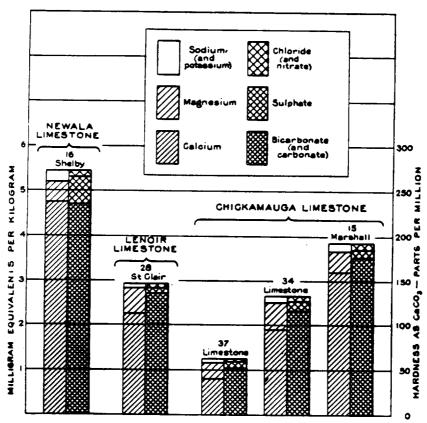


Fig. 46.—Graphic representation of analyses of water from the Newala limestone, Lenoir limestone, and Chickamauga limestone.

ODENVILLE LIMESTONE

The Odenville limestone has been observed in place only at Odenville, St. Clair County, although Butts has found its char-

acteristic fossils in loose chert elsewhere in northern Alabama. At the type locality it is an impure dark cherty limestone 50 feet thick. Although it is probably water-bearing, its small area of outcrop makes it of little importance as an aquifer.

MOSHEIM LIMESTONE

The outcrop of the Mosheim limestone is confined to the Cahaba Valley, where it is a thick-bedded fine-grained compact brittle bluish-gray limestone that develops a white or gray chalky crust upon the weathered surface. Butts estimates its thickness to be 50 feet. It is probably water bearing and may be expected to furnish dug and drilled wells in favorable topographic situations.

LENOIR LIMESTONE

General Features.—The Lenoir limestone occurs in a long, narrow belt extending the length of the Cahaba Valley through Shelby, Jefferson, St. Clair, and Etowah counties. In describing the formation in Alabama Butts' says:

"The Lenoir is prevailingly a dark, finely crystalline, medium thick-bedded, apparently nonmagnesian or low-magnesian limestone. Its freedom from magnesium is inferred from the fact that it is used in making cement, for which a high-magnesian limestone is unsuitable. It contains, however, some clay or other very fine-grained impurities, which are revealed on weathered surfaces as slightly raised gray anastomosing bands that form a rude network on the surfaces of the layers with a mesh about 1 inch across.

"Between Siluria and Pelham, in Cahaba Valley, the basal layers of the Lenoir are conglomeratic, the pebbles being mainly partly rounded or subangular chert and limestone. The best exhibition of this feature is at a small exposure between the highway and the right of way of the Louisville & Nashville Railroad about 1½ miles north of Siluria. * * This conglomeratic streak was traced northward to Pelham, where it seems to pass beneath the Louisville & Nashville Railroad station and marks the base of the Lenoir at that place. At Pelham it has decreased to a thick-

¹ Butts, Charles, op. cit., p. 104.

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ness of a foot or two of very small pebbles of limestone and probably other material in a limestone matrix.

"The thickness of the Lenoir in Cahaba Valley and as far north as Odenville is about 500 feet, although it may exceed this thickness locally. In the quarries at Rock Spring, 6 miles northeast of Gadsden, the Lenoir has greatly decreased in thickness."

In Bibb County certain layers in the Lenoir limestone were quarried for marble, known as the Pratt's Ferry marble. Prouty¹ gives the following analysis:

ANALYSIS OF LENOIR LIMESTONE (PRATT'S FERRY MARBLE)

Silica (SiO ₂)	0.16
Alumina (Al ₂ O ₃)	
Iron oxide (Fe ₂ O ₂)	
Lime (CaO)	55.70
Magnesia (MgO)	
Carbon dioxide (CO ₂)	

Water-Bearing Capacity.—In its water-bearing character the Lenoir is similar to the other Ordovician limestones. It contains solution cavity systems from which wells entering the solid rock draw their water and which feed a few springs. The subsoil derived from the Lenoir is clayey, and its permeability is low. Dug wells ending in the subsoil layers are charged slowly and, though furnishing adequate water for the average farm needs, can not be depended upon to meet heavy demands.

Quality.—The one sample of water from the Lenoir limestone which was analyzed (St. Clair County, No. 28) is similar to waters from other Ordovician limestones. It contained 132 parts per million of total solids and is predominantely calcium bicarbonate in character. (See fig. 46.)

ATHENS SHALE

The principal outcrop areas of the Athens shale are in Shelby and Bibb counties, where the formation extends from the inner edge of the Coastal Plain up the Cahaba Valley to Pelham. Smaller outcrops occur in Calhoun and Talladega counties. The

¹ Prouty, W. F., Preliminary report on the crystalline and other marbles of Alabama: Alabama Geol. Survey Bull. 8, p. 97, 1916.

formation is composed mainly of black fissile shale within which are included a few thin beds of dark limestone. At the base of the formation is a persistent bed of fossiliferous limestone 10 feet thick. The thickness of the Athens shale is variable over short distances. In Alabama it ranges between 15 and 300 feet. The formation is a poor aquifer and is of little importance as a source of ground water.

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LITTLE OAK LIMESTONE

General Features.—The Little Oak limestone crops out in a long, narrow band in the central part of the Cahaba Valley and in some of the low, elongated ridges in the western part of Calhoun County. It is a thick-bedded, coarsely crystalline limestone containing some chert. Locally the upper part of the formation is argillaceous, and it contains at least two thin bentonitic beds. The thickness of the formation ranges between 50 and 500 feet.

Water-Bearing Capacity.—The Little Oak limestone is cut by the usual water-bearing channels formed by solution along joints and bedding planes. These channels permit the circulation of ground water and supply drilled wells and springs. Dug wells on the outcrop of the formation are usually satisfactory. The water is of the calcium bicarbonate type.

CHICKAMAUGA LIMESTONE

General Features.—The Chickamauga limestone occurs in a wide area northwest of the old "Cahaba barrier" which divided the Alabama portion of the old Appalachian geosyncline during Ordovician and Silurian time. This dividing line followed the Cahaba Ridges to the latitude of Odenville, whence it continued northeastward across Calhoun and Cherokee counties to the Georgia State line. The Chickamauga limestone crops out in the Birmingham Valley, in the north half of the Cahaba and Coosa valleys, and in the Sequatchie, Wills, and Murphrees valleys.

In the Chickamauga limestone are included rocks of Richmond, Maysville, Trenton, Black River, and Stones River age, ranging from uppermost Upper Ordovician to upper Lower Ordovician. Thick to thin-bedded, compact to coarsely crystalline, and pure to argillaceous limestones are represented in this for-

^{*} Butts, Charles, op. cit., pp. 114-115.

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mation, which are described in detail by Butts.1 Local descriptions are contained in the county chapters of this report. The thickness of the Chickamauga ranges between 200 and 500 feet.

The following analyses represent Chickamauga limestone from an old quarry near Gate City, Jefferson County':

Silica (SiO ₂)	1	2
Iron oxide (Fe ₂ O ₂)	5.70	3.30
Calcium carbonate (CaCO:)	1.87	2.14
	91.16	91.33

1. Average sample from crusher; Henry McCalley, analyst.

2. Average of four samples; J. W. Miller, analyst.

Many of the limestones contain small amounts of magnesium carbonate, though few can be regarded as dolomitic.

Water-Bearing Capacity.—The Chickamauga limestones are usually good aquifers. In many places the beds are on edge and the solution-channel systems are unusually well developed. Drilled wells usually obtain water at depths less than 100 feet. Many springs are fed by these limestones, some with yields of more than 500 gallons a minute.

Dug wells in this formation are, for the most part, satisfactory, although in subsoil derived from the more argillaceous limestones their yields are small and they are unable to supply unusual demands for water.

Quality.—Waters from the Chickamauga limestone are calcium bicarbonate in character. They are much lower in magnesium than the waters from the Cambrian or Ordovician dolomites. In the seven waters analyzed the range in total dissolved solids was from 76 to 201 parts per million. Except in one spring water, which contained 40 parts of sodium, the other mineral constituents are low. (See Limestone County, Nos. 34, 35, 37, 40, and 41; Marshall County; No. 15; and Tuscaloosa County. No. 49; also fig. 46.)

SILURIAN SYSTEM

RED MOUNTAIN FORMATION

General Features.—The Red Mountain formation was deposited west of the "Cahaba barrier." It crops out in the Birmingham, Murphree's, Sequatchie, Wills, and upper Coosa valleys

Idem. pp. 119-133.
 Smith, E. A., Alabama Geol. Survey Bull. 8, p. 72, 1904.

and in two small areas in Lauderdale County. The formation is composed, for the most part, of sandstone, conglomerate, and shale. Interbedded with these clastic sediments and of local areal distribution are the beds of red iron ore upon whose utilization the extensive iron and steel industry of the Birmingham area depends. Many of the sandstones have a calcareous cement, the iron ore contains fragments of fossils composed of calcium carbonate, and in the northern part of the State some limestone beds occur with the sandstone and shale. The Red Mountain formation in Lauderdale County is composed entirely of limestone and is about 25 feet thick. The maximum thickness attained by the formation is about 700 feet.

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Water-Bearing Capacity.—The Red Mountain formation is a poor aquifer. The shales are not water-bearing, and most of the sandstones are of low permeability. Some shallow dug wells obtain water from weathered shaly sandstone, but many of these wells fail in dry seasons. Throughout the outcrop area of the formation there are a few small springs, which are fed by water stored in the weathered subsoff, but these springs are not trustworthy in times of subnormal rainfall.

In the red-ore mines east of Bessemer little water is encountered below sea level. Occasionally small flows averaging possibly 3 or 4 gallons an hour persist for a few months and then cease. These flows come from local reservoirs in the roof of the ore seam, which are known to the miners as "bleeders" and probably contain water that has been stored for a long time. The fact that the flow ceases after a few months suggests that the water is not in active circulation.

Quality.—The following analyses represent iron-mine waters from the shaly portions of the Red Mountain formation. Samples are predominantly sodium bicarbonate in character and may represent meteoric waters in which calcium and magnesium have been exchanged for sodium from the clay minerals. Analysis 1 represents a water which may be derived partly from the Fort Payne chert and can not, therefore, be taken as typical of the Red Mountain formation. (See fig. 47.)

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Analyses of iron-mine waters from Red Mountain formation.

Analyzed by Margaret D. Foster. Parts per million.

	1	2	3	
Silica (SiO ₂)	_		11	
Iron (Fe)	_	-	.04	
Calcium (Ca)	a/ 44	a/ 24	10	
Magnesium (Mg)	_	_	2.8	
Sodium (Na)	1	1.7050	207	
Potassium (K)	b/ 15	b/ 253	4.0	
Carbonate radicle (CO ₃)	5.9	22	5.9	
Bicarbonate radicle (HCOs)	151	443	519	
Sulphate radicle (SO ₄)	a/ 18	139	24	
Chloride radicle (Cl)	a/ 3.0	73	25	
Nitrate radicle (NO ₂)	.0	8.3	.21	
Total dissolved solids	b/166	730	548	
Total hardness as CaCO	123	105	b/ 36	
Date of collection (1929)	Sept. 28	Sept. 28	Sept. 28	

a/ By turbidity.

- 1. Sloss No. 1 mine, Jefferson County. Seep from roof, probably partly from Fort Payne chert.
- 2. Sloss No. 1 mine. Seep from iron ore in Red Mountain formation.
- 3. Sloss No. 2 mine. Seep from iron ore in Red Mountain formation. Vertical cover about 1,100 feet.

DEVONIAN SYSTEM

LIMESTONE OF HELDERBERG AGE

In the extreme northwest corner of Alabama, in Lauderdale County, is a small area in which limestone of Helderberg age occurs. The formation is composed of dull-gray thin-bedded earthy limestone and is 50 feet thick. Because of the small area of outcrop this formation is of little importance in Alabama as an aquifer.

b/ Calculated.

FROG MOUNTAIN SANDSTONE

The Frog Mountain sandstone was deposited in a broad belt that includes the Birmingham-Big Canoe Valley, Cahaba Ridges, Cahaba Valley, Coosa Ridges, and a part of the central Coosa Valley. Throughout the greater part of that belt it is less than 20 feet thick, but in Frog Mountain, Cherokee County, it attains a thickness of 250 feet. The formation is diverse in character, containing beds of coarse friable thick-bedded sandstone, chalky fossiliferous rock, and quartzitic sandstone.

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Throughout the greater part of its outcrop the Frog Mountain sandstone is thin and closely resembles the sandy beds of the Red Mountain formation in appearance and water-bearing character. It is not an important aquifer.

DEVONIAN OR CARBONIFEROUS SYSTEM

CHATTANOOGA SHALE

General Features.—The Chattanooga shale was originally deposited over all of northern Alabama northwest of the Coosa River, and it is now exposed in all the valleys where erosion has removed the overlying formations. North of the latitude of Anniston and west of Lookout Mountain it is a fissile black carbonaceous shale 5 to 25 feet thick. Locally it contains thin sandstone layers. At Birmingham and in the Cahaba and Coosa valleys the formation is 2 feet thick and composed of green and purple shale.

Water-Bearing Capacity.—This formation, both because of its thinness and its lithologic character, is a poor aquifer. Several of the hydrogen sulphide bearing springs of northern Alabama are either on or near the outcrop of the Chattanooga shale. These springs flow a few gallons an hour, have a strong hydrogen sulphide odor, and were formerly considered to possess medicinal value. White Sulphur Spring, DeKalb County; Blount Springs, Blount County; and the Ingram Wells, Calhoun County, were health resorts in the last century, and their crumbling buildings testify to the change in medical opinion regarding the curative powers of hydrogen sulphide waters.

Quality.—The following analyses were made by Dr. R. S. Hodges, of the Geological Survey of Alabama. They represent waters that have probably derived their hydrogen sulphide from the Chattanooga shale.

Analyses of hydrogen sulphide water a

		Parts per million				
	1	2	3	4		
Silica (SiO ₂)	25.8	26.5	19.7	16.6		
Iron (Fe)		.8	1.0	.8		
Calcium (Ca)		51	53	51		
Magnesium (Mg)	56	24	25	23		
Sodium (Na)	16	234	232	218		
Potassium (K)	3.2	14	14	12		
Bicarbonate radicle (HCOs)	294	279	276	257		
Sulphate radicle (SO.)	304	Trace	Trace	Trace		
Chloride radicle (Cl)	4	325	320	297		
Nitrate radicle (NO:)	i —	-	<u> </u>	<u> </u>		
Hydrogen sulphide (H2S)	8.1	56.5	54.2	53.1		

² Smith, E. A., The underground water resources of Alabama, pp. 77-79, 1907.

- 1. White Sulphur Springs, DeKalb County.
- 2, 3, and 4. Blount Springs, Blount County. Small amounts of lithium (Li), barium (Ba), strontium (Sr), bromine (Br), and iodine (I) were also found.

The waters are highly mineralized and usually contain enough hydrogen sulphide to impart a decidedly disagreeable taste and odor.

CARBONIFEROUS SYSTEM

MISSISSIPPIAN SERIES

FORT PAYNE CHERT

General Features.—The Fort Payne chert is exposed in all the anticlinal valleys from which the overlying rocks have been eroded, and it occupies large areas on the Highland Rim in Lauderdale, Limestone, and Madison counties.

On the outcrop the Fort Payne is usually composed of white to reddish iron-stained chert. Weathered material breaks readily along incipient fractures, and broken chert fragments accumulate upon the gentler slopes of the formation. Fresh exposures of the Fort Payne are calcareous, and lenses of almost chert-free limestone occur. In Lauderdale County 60 feet of dark siliceous shale occurs at the base of the formation. The Fort Payne ranges from 100 to 200 feet in thickness.

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Water-Bearing Capacity.—This formation is an important aquifer in northern Alabama. The limestone in the cherty beds is readily dissolved, and its removal leaves a porous ground-water reservoir within the chert. This reservoir supplies many drilled wells yielding 100 gallons or more a minute and feeds several large springs. Where the beds dip steeply the incipient cracks in the chert have opened, and its porosity has thereby been increased. The surficial material derived from this formation is composed of chert and clay and generally has a high porosity. Dug wells ending in it are usually satisfactory.

Quality.—The Fort Payne chert yields waters which predominate in calcium bicarbonate. The other mineral constituents are usually very low. Most of the waters contain less than 200 parts per million of total solids and are well suited for domestic use. (See Blount County, No. 26; DeKalb County, Nos. 55 and 57; Etowah County, No. 51; Lauderdale County, No. 44; Limestone County, Nos. 26 and 46; and St. Clair County, Nos. 65 and 67; also fig. 47.)

TUSCUMBIA LIMESTONE

General Features.—The Tuscumbia limestone was deposited over the whole of what is now the Cumberland Plateau and the Highland Rim sections of northern Alabama. On paleontologic grounds the formation is divided into two parts—the Warsaw limestone, which was laid down over the whole area, and the overlying St. Louis limestone, which was deposited east of the longitude of Decatur. In thickness the Warsaw limestone ranges from 15 to 200 feet and the St. Louis limestone has a maximum of 175 feet. Both are exposed in northeastern Alabama, and the Warsaw crops out over large areas in Lauderdale, Colbert, Lawrence, Limestone, Madison, and Morgan counties.

Lithologically the limestones are similar. For the most part they are thick bedded, gray, cherty, coarsely crystalline, and fossiliferous, but beds of compact dark-gray limestone occur in the St. Louis.

Water-Bearing Capacity.—The Tuscumbia limestone is an excellent aquifer. Throughout northeastern Alabama the beds contain elaborate systems of solution channels, which supply many large springs. Big Spring, at Huntsville, and the Tuscumbia Spring, both of which are supplied by the Warsaw limestone, are described on pages....... Drilled wells that penetrate

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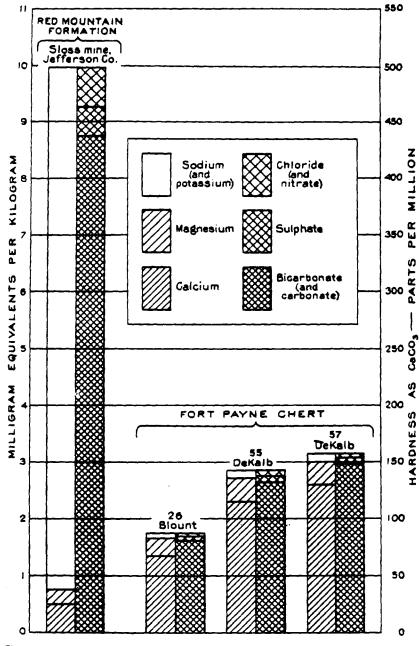


Fig. 47.—Graphic representation of analyses of waters from the Red Mountain formation and Fort Payne chert.

active solution cavities are capable of yielding large quantities of water. Other wells that fail to encounter such cavities have yields limited to the small quantities of water which can be supplied from minute fractures in the rock. Fortunately the solution cavity systems are so completely distributed throughout the limestone that few wells 50 to 100 feet in depth fail to penetrate one or more water-filled openings.

Dug wells usually obtain their water from the cherty subsoil derived from the weathering of the limestones. The porosity of this subsoil is sufficient to supply most such dug wells with adequate water for the average domestic needs.

Quality.—The Tuscumbia limestone yields calcium bicarbonate waters of fairly uniform mineral content. The eight samples analyzed range from 85 to 280 parts per million of total solids, but most of them contain between 115 and 170 parts per million. (See Colbert County, Nos. 22 and 48; Lauderdale County, Nos. 49 and 50; Lawrence County, No. 41; Madison County, Nos. 27, 45, and 53; and Morgan County No. 2; also fig. 48.

STE. GENEVIEVE LIMESTONE

General Features.—The Ste. Genevieve limestone occurs in northern Alabama along the Tennessee River, and fossils derived from the formation have been found in Little Wills Valley, 6 miles north of Gadsden.

Through the greater part of its outcrop in Alabama the formation is composed of thick-bedded light-gray colitic limestone. It ranges from 75 to 100 feet in thickness in Jackson and Marshall counties and from 10 to 15 feet in Lawrence County. In Colbert County the lithologic character of the Ste. Genevieve changes, and the formation is represented by 30 to 70 feet of marl, which Butts' describes as "a very thinly fissle, soft, fragile, greenish or bluish, probably calcareous rock which crumbles at touch and weathers to clay." Below this mark is a persistent bed of argillaceous limestone.

Water-Bearing Capacity.—The limestone facies of the Ste. Genevieve is abundantly water bearing. Solution cavities in the bedded rock supply drilled wells and springs, and the weathered subsoil, though of fairly low porosity owing to the abundance of residual clay, furnishes water to dug wells. The marls in Colbert

¹ Butts, Charles, op. cit., p. 182.

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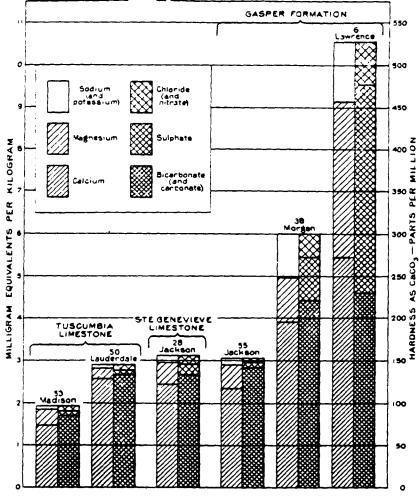


Fig. 48.—Graphic representation of analyses of waters from the Tuscumbia limestone, Ste. Genevieve limestone, and Gasper formation.

County, however, furnish only a little water, usually of poor quality.

Quality.—The oolitic limestone yields normal calcium bicarbonate waters. One water analyzed contained 178 parts per million of total dissolved solids and is a typical limestone water. Water from the marls is much more highly mineralized and often unsuited for domestic use. The most highly mineralized water examined came from a drilled well 45 feet deep in Colbert County. It contained 3,892 parts per million of total dissolved solids,

of which 2,218 parts were sulphate. Although this analysis can not be considered typical, it shows the unfavorable quality of many of the waters that may be yielded by the marly facies of the Ste. Genevieve. (See Colbert County, Nos. 13 and 16, and Jackson County, No. 28; also fig. 48.)

BETHEL SANDSTONE

General Features. —The Bethel sandstone crops out in a small area in western Colbert County. It is a thick-bedded coarse-grained to thin-bedded shaly sandstone whose maximum observed thickness in Alabama is 20 feet. Locally it is impregnated with asphaltum.

Water-Bearing Capacity.—A dug well in sec. 2, T. 4 S., R. 14 W., in Colbert County was the only well noted that obtained water from this formation. The well was reported to be satisfactory. It is probable that the Bethel sandstone will furnish good wells locally, but because of its scanty distribution it is of little importance as an aquifer.

Quality.—The water from the well in Colbert County is calcium bicarbonate in character, but the partial analysis (Colbert County, No. 17) indicates organic pollution, and the water is probably not typical of the formation.

GASPER FORMATION

General Features.—The Gasper formation was deposited over northwestern Alabama as far south as Bessemer. The principal exposed areas are in the northern counties, along the Tennessee River, where the formation crops out in the Jackson County Mountains district of the Cumberland Plateau and on the lower slopes below the northward-facing escarpment of Little Mountain.

North of the Tennessee River the Gasper is composed of about 100 feet of thick-bedded light-gray limestone, much of which is colitic but which contains beds of light-gray compact lithographic stone. South of the Tennessee River the formation is mainly marl but contains a few beds of limestone. In Colbert County there is a thin persistent bed of asphaltic limestone at the base of the formation.

Water-Bearing Capacity.—North of the Tennessee River the Gasper formation crops out on the lower slopes of the dissected

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remnants of the Cumberland Plateau. The limestones are cut by solution channels that feed many springs, some of which have large flows. Some drilled wells yielding more than 100 gallons a minute also obtain their water from the solution cavities in the limestone. Dug wells usually end in the subsoil derived from the weathering of the bedrock. It is fairly permeable, and most of the dug wells are reliable.

South of the Tennessee River the Gasper is a poor aquifer, as the marl yields little water except from the weathered surficial material. There are a few springs that issue from limestone layers in contact with underlying shaly marl.

Quality.—The analyses indicate that waters from this formation reflect the varied lithologic character of the rocks. Those from the eastern part of the outcrop area are typically limestone waters of moderate mineral content, but as the lithologic character changes to marl the waters become more highly mineralized with increasing content of sulphates. (See Colbert County, No. 44; Jackson County, Nos. 34 and 55; Lawrence County, No. 6, and Morgan County, Nos. 38 and 50; also fig. 48.)

In the U. S. Geological Survey laboratory a sample of marl from the Gasper formation in Colbert County was digested with distilled water saturated with carbon dioxide. After six days the water was analyzed by Miss Foster, with the following results:

ANALYSIS OF WATER FROM MARL SAMPLE

	Parts Per Million
Calcium (Ca)	236
Magnesium (Mg)	
Bicarbonate radicle (HCO ₂)	
Sulphate radicle (SO ₄)	110
Chloride radicle (Cl)	2

CYPRESS SANDSTONE AND GOLCONDA FORMATION

The Cypress sandstone and the Golconda formation have been recognized by Butts' in northern Alabama. Because of their meager distribution and small outcrop areas nothing is known of their water-bearing capacity.

¹ Butts, Charles, op. cit., pp. 189-192.

HARTSELLE SANDSTONE

General Features.—The Hartselle sandstone is present over a large area in Alabama. In the extreme northern part of the State the eastern limit of the formation is near the line between Morgan and Marshall counties, and farther south the formation extends eastward into the Cahaba Valley.

The formation is composed mainly of thick-bedded medium-grained sandstone, but locally it is thin bedded and contains some layers of shale. The degree of cementation is variable. At Irondale, in Jefferson County, and south of Hillsboro, in Lawrence County, the sandstone is soft and friable, but over the greater part of its outcrop it is well cemented, and in the upturned beds in Rocky Row, Jefferson County, it is quartzitic. It ranges from 5 to 200 feet in thickness, and the thinner part is near the eastern edge of the area of deposition.

Water-Bearing Capacity.—Throughout the greater part of its outcrop the Hartselle sandstone has fair porosity and yields moderate quantities of water to drilled wells. A 6-inch domestic well situated anywhere upon the outcrop of the formation is almost certain to supply sufficient water for the average Alabama farm, but wells designed for industrial use or for public water supplies seldom yield as much as 50 gallons of water a minute.

There are a few flowing wells in Shades Valley, Jefferson County, which are probably fed by the Hartselle sandstone. These wells are diamond-drill holes sunk in exploration for iron ores. They flow at the rate of a few gallons a minute. At Gate City, northeast of Birmingham, there are a few wells between 25 and 344 feet in depth and flowing at the rate of 50 to 100 gallons a minute each. These wells are down the dip from the outcrop of the locally friable and loosely cemented Hartselle sandstone, and it is probable that the water comes from this formation.

Quality.—The Hartselle sandstone yields waters which are widely variable in mineral content and chemical character, as shown by three analyses. The waters are calcium bicarbonate in character with moderate amounts of sulphate. (See Blount County, No. 10; Colbert County, No. 46; and Morgan County, No. 15; also fig. 49.)

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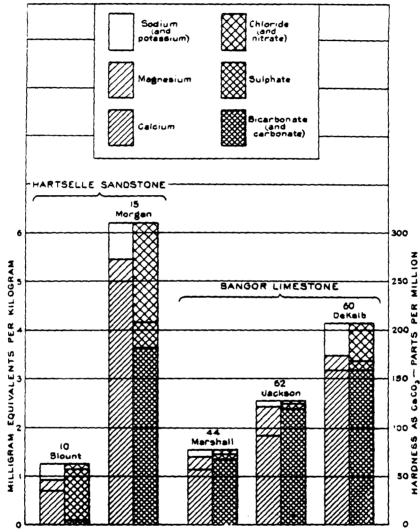


Fig. 4.-Graphic representation of analyses of waters from the Hartsell sandatone and . Bangor limestone.

BANGOR LIMESTONE

General Features.—The Bangor limestone occurs over a large part of northwestern Alabama. The eastern and southern edge of the area in which it was deposited follows the southeast side of Lookout Mountain, crosses the Cahaba Ridges diagonally to a point 5 miles south of Birmingham, turns north to Boyle's

Gap, on the eastern edge of the Warrior Basin, and continues westward to the Mississippi State line. Over the greater part of this area the Bangor is a thick-bedded dark-bluish crystalling colitic limestone containing some interbedded shale. In Colbert and Franklin counties the colitic beds attain a thickness of 40 to 50 feet and are quarried at Rockwood and east of Russellville. The maximum thickness attained by the formation is about 700 feet. To the south and east the limestone facies of the Bangor grade laterally into the Floyd shale.

The following analyses show the character of the Bangor limestone:

Analyses of Bangor limestone a

	1	2	3	4	5
Silica (SiO ₂)	2.05	4.45	2.80	1.05	.30
Iron oxide and alumina (Fe ₂ O ₂ +A1 ₂ O ₂) Calcium carbonate (CaCO ₂)	.76	3.30	.70	.82	_
Magnesium carbonate (MgCO _s)				.71	.39

- a 1 to 4 from Alabama Geol. Survey Bull. 8, p. 71, 1904. 5 from Tuomey, Michael; Second biennial report on the geology of Alabama, p. 181, 1858.
- Average sample of 150 feet of rock used as flux, Compton quarry, north of Dale, Blount County. J. L. Beeson, analyst.
 - 2, 3. Stock-house samples, Compton quarry. W. B. Phillips, analyst.

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- 4. Average of eight analyses from Blount Springs quarry, Blount County. Henry McCalley, J. L. Besson, and J. R. Harris, analysts.
 - 5. Oolitic limestone from Russellville. J. W. Mallet, analyst.

Water-Bearing Capacity.—The Bangor limestone in the northern limestone valleys supplies many large springs, and its solution channels readily yield water to drilled wells. The formation contains sufficient chert to form a fairly permeable subsoil, in which many dug wells end. Those wells are usually satisfactory for farm use.

The towns of Bridgeport and Guntersville, in the Sequatchie Valley, obtain their public water supplies from springs issuing from the Bangor limestone.

Quality.—The Bangor limestone yields typical calcium bicarbonate waters which contain usually between 100 and 250 parts per million of total dissolved solids. (See DeKalb County, Nos. 47, 60, and 61; Etowah County, No. 47; Franklin County, No. ontinues
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43; Jackson County, Nos. 56 and 62; Jefferson County, No. 51; Lawrence County, No. 46; and Marshall County, Nos. 41, 42, and 44; also fig. 49.)

PENNINGTON FORMATION

Butts' describes the Pennington formation in Alabama as follows:

"Above the Bangor limestone lies a varying thickness of limestone and shale with some beds of red shale. * * * The red shale is well exposed on the roads up Sand and Lookout mountains.

"The Pennington beds in this area are composed mainly of argillaceous, partly cherty limestone, with which are associated beds of shale, some of them red, the red shale being the striking and characteristic feature of the Pennington formation to the north. The beds referred to as the Pennington are probably nowhere more than 200 feet thick and commonly not more than 50 feet thick."

The limestone beds in this formation are water bearing, and some contact springs occur at the base of limestone layers that rest upon shale beds. This formation is, however, of little importance as an aquifer.

FLOYD SHALE

General Features.—The Floyd shale crops out in a series of northeastward-striking bands that extend eastward from the southern and eastern boundary of the Bangor limestone and are found in the Birmingham Valley, Cahaba Valley, Coosa Ridges, and Coosa Valley. The formation is described by Butts' as follows:

"The Floyd is predominantly a shale, much of it black and fissile but most of it greenish and of crumpled and fragile, crumbling texture, so that it breaks up on handling into small and still smaller flakes with slickensided and greasy-looking surfaces. Interbedded with the shale are many lenses and layers of sandstone and fewer thin layers

¹ Butts, Charles, op. cit., pp. 199-201. ² Butts, Charles, op. cit., p. 202.

of limestone. The sandstone is generally hard, fine grained, and greenish. It commonly occurs as lenses in the shale, as can be seen in moderately high railroad cuts. Continous beds of thick-bedded or thin-bedded sandstone also occur. The sandstone is distributed throughouth the shale, both areally and vertically, and the soil over most of the area is full of larger or smaller fragments of it."

The formation is variable in thickness and attains a probable maximum of 9,000 feet.

Water-Bearing Capacity.—The shale facies of the Floyd, where unweathered, yields little water. Upon weathering, however, the shale is broken up into small fragments, which give a fair degree of permeability to the subsoil. This material supplies water to many dug wells. Further weathering reduces the shale to a tight clay with a greatly lessened permeability. Such completely weathered material supplies little water, and dug wells ending in it have small and usually inadequate yields.

Successful drilled wells ending in the Floyd are exceptional. The town of Columbiana obtains its public supply from two drilled wells 87 and 90 feet deep, situated near the great thrust fault between the Floyd shale and the Talladega slate. The wells have been pumped at the rate of 200 gallons a minute with little drawdown, showing a high specific capacity. It is probable that considerable fracturing adjacent to the fault has increased the permeability of the rocks.

Springs are exceptional in the Floyd area. Hall's Spring, on the southwest slope of Red Mountain near Bessemer, in Jefferson County, yields 25 gallons a minute. It is probably fed by a thick limestone bed within the shale.

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Quality.—Waters from the Floyd shale vary widely in mineral content. Most of those analyzed contained from 50 to 250 parts per million of total dissolved solids, with calcium bicarbonate as the predominating mineral constituent. An exceptionally highly mineralized water from a dug well 22 feet deep in Calhoun County contained 3,300 parts per million of dissolved solids, mainly calcium sulphate. Fortunately, such water is not common in this formation. (See Calhoun County, Nos. 7 and 17; Jefferson County, No. 114; Shelby County, Nos. 19 and 39; and Tuscaloosa County No. 24; also fig. 50.)

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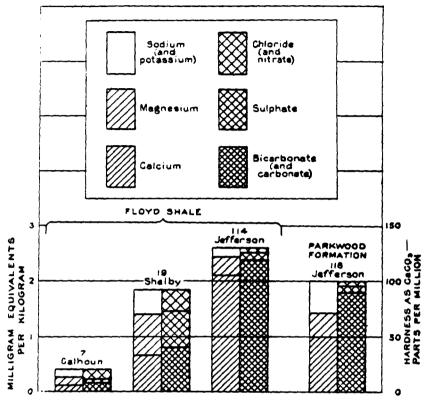


Fig. 50.—Graphic representation of analyses of waters from the Floyd shale and Parkwood formation.

PARKWOOD FORMATION

General Features.—The Parkwood formation occurs in the Shades Valley, Jefferson County, in the Cahaba Valley, and in the Coosa Ridges bordering the elongate outcrops of the Floyd shale. Butts 'gives the following description of the formation:

"The Parkwood is made up of shale and sandstone. The shale is predominantly clayey, and the sandstone either silicious or more or less feldspathic (arkose), which occurs mostly in strata that have a maximum thickness of 100 feet and are made up of layers from a few inches to a foot or more in thickness, and it is generally composed of a medium-sized grain. The color of both shale and sandstone is invari-

¹ Butts, Charles, op. cit., pp. 205-206.

ably gray in the fresh condition. The sandstones of the formation make ridges, as is shown on the Bessemer and Leeds topographic maps. Bluff Ridge and Bee Ridge west of Genery Gap, Little Shades Mountain, and Bald Ridge south of Birmingham in Shades Valley, and Pine Ridge and many unnamed ridges southeast and northeast of Irondale are examples. In their general physical aspects the Parkwood rocks resemble those of the overlying Pennsylvanian much more closely than they do those of the Floyd shale.

"The thickness of the Parkwood, as determined from its dip and the width of its outcrop, is 2,200 feet southeast of Trussville, about 2,000 feet southeast of Irondale, and 1,500 feet west of Genery Gap. It is about 1,000 feet thick east of the Coosa coal field and 400 feet thick on the east slope of Blount Mountain."

Water-Bearing Capacity.—Little information concerning the water-bearing character of the Parkwood formation was obtained. In general the more massive sandstones resemble the overlying Pottsville sandstones in that they yield moderate quantities of water to drilled wells; and the shales and thinner sandstones behave in the manner of the underlying Floyd shale.

Quality.—Only one analysis of Parkwood water was obtained. The water came from a small spring on a thin sandstone layer and contained 127 parts per million of total solids mainly calcium bicarbonate. (See fig. 50.)

PENNSYLVANIAN SERIES

POTTSVILLE FORMATION

General Features.—The Pottsville formation is exposed at the surface over a large part of northern Alabama. The formation is coextensive with the Warrior Basin, Blount Mountain, Sand Mountain, and Lookout Mountain; it caps the table-like remnants of the Cumberland Plateau north of the Tennessee River and forms the larger part of the Coosa Ridges and the Cahaba Ridges. The sandstone beds are resistant and form either outward-facing escarpments surrounding the Pottsville area or, where the strata are folded, as in the Cahaba and Coosa ridges, monoclinal mountains that rise above the adjacent shale and limestone valleys.

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rosed at formapuntain, able-like Tennessee ad the Carm either e area or, sa ridges, shale and The Pottsville formation is composed of a rather monotonous series of thick to thin bedded sandstones and shales. Many coal seams, some of which are of great economic value, occur in the upper part of the formation. The Pottsville attains a maximum thickness of 9,000 feet in the south end of the Cahaba coal field.

Water-Bearing Capacity.—The Pottsville formation is an important aquifer in northern Alabama, not because of the quantity of water obtainable from it, for it affords few large supplies, but because of the fact that shallow drilled wells situated almost anywhere upon the outcrop encounter water-bearing sandstones that yield adequate quantities of water for farm use. These drilled farm wells are generally not more than 100 feet in depth, and most of them are successful. Larger quantities of water, designed for industrial use or public supplies, are not everywhere obtainable from this formation, and it is probable that there will be an increased future utilization of surface water for public supplies in the Pottsville area.

At the present time the wells having the largest yields from the Pottsville are at Cullman, in Cullman County, where the best well is 550 feet deep and is pumped at the rate of 175 gallons a minute; and at Jasper, Walker County, where an 8-inch well 465 feet deep yields 250 gallons a minute. Both of these wells draw from several water-bearing sandstone layers, and their yields are exceptional. Deep wells designed for public supplies at Albert-ville and at Boaz, in Marshall County, yield less than 100 gallons a minute.

Most of the farm wells on this formation are drilled and supply sufficient water for domestic use. Dug wells end in sandy subsoil derived from the weathering of the formation. Though less reliable than the drilled wells they are fairly satisfactory. There are few wells, either drilled or dug, that end in shale.

Many springs are fed by the Pottsville. Most of them are in ravines and are fed by waters stored in the subsoil on the adjoining slopes, but some issue from sandstone beds that crop out in valley sides. Both types usually have small yields. An exceptionally large spring near Haleyville, Winston County, issues from a horizontal crack between two massive sandstone beds on the side of a ravine. On August 28, 1929, this spring flowed at the rate of 200 gallons a minute. It furnishes the town water system.

Quality.—Waters of the Pottsville formation are extremely variable in mineral content, ranging from less than 20 to more

than 600 parts per million of total dissolved solids, and waters from coal seams or from wells adjoining coal mines may contain over 2,000 parts per million. The waters are also variable in chemical content. Most of those analyzed predominate in calcium bicarbonate, but distinctly sodium bicarbonate waters and waters with intermediate calcium and sodium ratios are found. The content of other mineral constituents is also variable. The

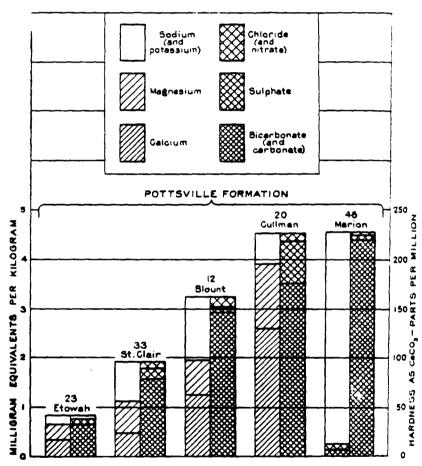


Fig. 51.-Graphic representation of analyses of waters from the Pottsville formation.

sodium bicarbonate and intermediate waters were probably derived from original calcium bicarbonate waters by exchange of calcium and magnesium for sodium of the clay minerals in the rocks, as described on pages 87-88. (See Bibb County, No. 9; Blount County, No. 12; Cherokee County, No. 17; Cullman Coun-

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ty, Nos. 25, 26, 27, 33, and 48; DeKalb County, Nos. 3, 33, and 53; Etowah County, No. 23; Fayette County, Nos. 10, 24, 28 and 29; Jackson County, No. 39; Jefferson County, No. 3; Madison County, Nos. 4 and 12; Marshall County, Nos. 32 and 36; Marion County, Nos. 5 and 10; Morgan County, No. 24; St. Clair County, No. 33; Tuscaloosa County, No. 34; Walker County, Nos. 9, 10, 24, 25, 38, 42, 43, 44, and 49; and Winston County, Nos. 3, 6, 16, 22, 43, 45, and 46; also fig. 51.)

The iron content of some of the Pottsville waters is so high as to cause staining of vessels and to render the waters unsuitable for laundry purposes. This iron appears to be furnished by pyrite occurring in shale and particularly in certain thin coal beds penetrated by the wells.

In areas from which the underlying coal has been mined the well water may contain large amounts of sulphates derived by the oxidation of the pyrite contained in the coal. Some of the coal-mine waters are acid. The following table gives analyses of typical coal-mine waters in Alabama:

JEFFERSON COUNTY

Area 1,120 square miles; population 431,493 (census of 1930).

Jefferson County lies near the south end of the Valley and Ridge province, in northern Alabama. It is the largest manufacturing county in Alabama, owing to the presence of red iron ore and to the position of three coal fields that adjoin the iron-ore deposits. Agriculture is of minor importance, and in 1930 only 25 per cent of the total area was in farm land.

Birmingham, with its blast furnaces and steel mills, is the industrial center of the county. In 1930 the city had a population of 259,678. Adjoining Birmingham on the south is Bessemer, with a population of 20,721. Like Birmingham, Bessemer has furnaces and steel and pipe mills. Fairfield, also adjoining Birmingham, had 11,059 inhabitants in 1930. At the extreme east edge of Jefferson County, in the latitude of Birmingham, is Leeds, with a population in 1930 of 2,529. It has a cement mill and a brick plant. Tarrant City, with a population of 7,341; Homewood with 6,103, Lipscomb with 1,774; Brighton with 1,708, and Irondale with 1,517 are other urban centers. North and west of Birmingham are the small coal-mining settlements, Morris, Sayre, Cardiff, Brookside, Adamsville, Palos, Porter, Short Creek, Toadvine, and Adger. Their population varies from year to year with the coal production.

Jefferson County is well served by railroads. The Atlanta, Birmingham & Coast, the Birmingham Southern, the Birmingham Belt, the Central of Georgia, the Illinois Central, the Louisville & Nashville, the Mobile & Ohio, the Seaboard Air Line, the Southern, and the St. Louis-San Francisco railways all enter the county and serve as arteries of distribution for the manufactured products of Birmingham and Bessemer.

GEOLOGY

With the exception of the two lower formations the entire Paleozoic column outcropping in Alabama is represented in Jefferson County. The oldest rocks belong to the Rome formation and are composed of reddish to purplish finely laminated shale with some interbedded sandy shale and a few thin beds of limestone. This is overlain by the Conasauga formation, composed of a finely crystalline limestone which develops a banded appearance upon weathering, owing to the presence of alternating light and dark layers. Both of these formations are of Cambrian age.

Overlying the Conasauga are the Ketona, Copper Ridge, and Chepultepec dolomites of Cambrian or Ordovician age. These dolomites are somewhat variable in chemical composition, and are distinguished in the field, after some practice, by the character of the weathered chert which they yield.

Resting upon the Chepultepec dolomite is the Longview limestone, of Ordovician age, which, with the overlying Newala limestone, is extensively quarried for lime burning. Both formations are composed of a pure crystalline limestone excellently suited for the manufacture of chemical lime. Resting upon the Newala is the Mosheim limestone, which in turn is overlain by the Lenoir limestone, the Athens shale, and the Little Oak limestone. The three latter formations crop out to the southeast of the Cahaba barrier. On the northwest side of the barrier Ordovician limestones belonging to several stages are grouped under the name Chickamauga limestone.

Resting upon the Ordovician limestones and cropping out on both sides of the Birmingham Valley is the Red Mountain formation, composed of sandstone and shale, a small amount of limestone, and the red iron ore that gives the mountain its name. It is of Silurian age. Ulrich has shown that the lower part is of late Medina age and the upper part of early Niagara age.

Overlying the Red Mountain formation in places are the Frog Mountain sandstone and the Chattanooga shale. In Jefferson County both of these formations are thin and of only local distribution. They are in turn overlain by the Fort Payne chert, of Mississippian age. Resting upon the Fort Payne is the Warsaw limestone, which is overlain by the Gasper formation. Both are dominantly limestones and of Mississippian age. The Gasper is succeeded by the Hartselle sandstone. In Jefferson County the Hartselle is a massive, thick-bedded yellowish to gray sandstone, in places friable but for that most part tightly cemented with quartz. The Bangor limestone succeeds the Hartselle sandstone. In the eastern part of the county the Bangor is represented by the Floyd shale, which is composed of a great thickness of gray to brown thin fissile crumbly shale in places, with a few sandstone layers and thin intercalated beds of limestone. The lateral transition from the Floyd to the Bangor appears to be gradual, and it is probable that the Floyd shale was deposited nearer the Mississippian shore than the Bangor was.

¹ Butts, Charles, Geology of Alabama: Alabama Geol. Survey Special Rept. 14, p. 135, 1926.

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Overlying the Floyd shale in the eastern part of Jefferson County is the Parkwood formation, of Mississippian and possibly in part of Pennsylvanian age. It is composed of shale and sandstone. The shale somewhat resembles that of the Floyd formation, but on the whole it is more sandy and likely to be greenish brown rather than gray. The sand interbedded in the Parkwood ranges from fine material of siltlike character to sand that is decidedly gritty.

The youngest of the Paleozoic rocks exposed in this county belong to the Pottsville formation, of Pennsylvanian age. This formation is made up of sandstone, conglomerate, and shale. Some of the shale beds are without calcium carbonate, and some are more or less limy. Butts recognizes a number of sandstone and conglomerate members of this formation. In the Shades Valley and Cahaba coal field he has differentiated the Straven conglomerate, the Rocky Ridge sandstone, the Chestnut sandstone, the Pine sandstone, and the Shades sandstone members; also the sandstone of Bee Ridge, the sandstone of Bluff Ridge, and the sandstone of Little Shades Mountain. In the Cahaba Valley and the Coosa coal field he recognizes the Straight Ridge and Wolf Ridge sandstones. The distribution of these members is shown in the Biirmingham and Bessemer-Vandiver folios of the Geologic Atlas of the United States.

In Jefferson County, as elsewhere throughout the Valley and Ridge province in Alabama, the structural trend is southwest. A series of anticlines and synclines, paralleled by thrust faults and cut by cross faults, extend across the county. Details of these features are given by Butts in the folios already cited.

In the northwest part of the county is the Sequatchie anticline, which plunges rapidly to the southwest and disappears in Tuscaloosa County. Southeast of the Sequatchie anticline is the Coalburg syncline, which forms the greater part of the Warrior coal field. The Opossum—Murphrees anticline brings up rocks of Cambrian and Ordovician ages, which crop out in the northern part of Birmingham and extend to the northeast along Murphrees Valley. South and east of Birmingham is the Birmingham anticline, which is occupied by Jones Valley. It extends to the northeast where it joins the anticline occupied by the Coosa River in Etowah and Cherokee counties. Separating the anticlinal valleys is the Blount Mountain syncline, which is low in the vicinity

¹ Butts, Charles, U. S. Geol Survey Geol. Atlas, B'rmingham folio (No. 175), 1910; Bessemer-Vandiver folio (No. 221), 1927.

of Birmingham but forms Blount Mountain in the northern part of the county. In the Cahaba Ridges, east of Birmingham, the Pennsylvanian rocks are folded into parallel ridges, and on the extreme eastern edge of the county the Cahaba anticline again brings Ordovician rocks to the surface. In general the larger anticlines expose Cambrian and Ordovician rocks, and the synclinal axes are occupied by rocks of Pennsylvanian age. All the anticlines are bordered by thrust faults in which the direction of movement is from the southeast, causing the rocks to move to the northwest.

PHYSIOGRAPHY

Jefferson County lies partly in the Valley and Ridge province and partly in the Cumberland Plateau. The boundary between the two crosses the county on the northwest side of Opossum Valley.

The Warrior Basin is a single physiographic unit lying within the Cumberland Plateau. It is an area of moderate relief and a roughness which suggests its maturity. The drainage pattern is dendritic. Most of the streams flow to the west and northwest and are tributary to the Locust Fork of the Warrior River. Because of the roughness of this part of the county roads are winding, and the numerous branch railroads that serve the coal mines of the Warrior Basin have steep gradients. The rocks are, for the most part, flat-lying. The three major folds that cross this area—the Arkadelphia syncline, the Sequatchie anticline, and the Coalburg syncline—are not structurally conspicuous and, because of their gentle dips, do not have physiographic expression.

In that part of Jefferson County lying within the Valley and Ridge province are several smaller but distinctive physiographic units. East of the Warrior Basin is the Birmingham Valley, which is divided into Opossum Valley on the northwest and Jones Valley on the southeast. Each part of the Birmingham Valley follows the crest of an anticline, and they are separated by a low synclinal ridge, which becomes marked in Blount Mountain, to the northeast. The floors of these anticlinal valleys rise above the Warrior coal field, and drainage flows from the valley to the northwest across the Warrior field.

Extending the length of the county on the east side of Jones Valley is Red Mountain, formed by the southeastward-dipping

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beds of the Red Mountain formation, which stand in a prominent northwestward-facing scarp conspicuous from any point in the Birmingham Valley. Iron ore has for many years been mined on Red Mountain in the vicinity of Birmingham, and the old opencut workings can be seen for many miles. South and east of Red Mountain is the Shades Valley, eroded in the soft Floyd shale. Still farther to the southeast are the Cahaba Ridges, formed by the outcrops of conglomerate and hard sandstone members of the Pottsville formation. Individual ridges are known as Shades Mountain. Flat Ridge, Blackjack Ridge, Pine Mountain, Chestnut Mountain, and Owen Mountain. The structural trend of these sandstone ridges is southwest, in conformity with the general structural relation of the province. The extreme eastern corner of the county is crossed by the Cahaba Valley, excavated in the Ordovician rocks exposed in the Cahaba anticline.

In Jefferson County the physiographic expression of the structural and stratigraphic character of the rocks is well marked. In general the anticlinal valleys are higher than the synclinal plateaus, and the major drainage lines are confined to the synclines. Birmingham is situated in a valley higher than the Cahaba River, to the southeast, and the Black Warrior River to the northwest. The water used for its public supply comes from the Cahaba River and must be piped over several intervening ridges and raised to the storage reservoir on Shades Mountain, adjacent to the city.

GROUND WATER

The rocks that crop out in Jefferson County may be divided into nine groups, based on the character and occurence of the ground water which they contain. In these groups are found rocks of similar lithologic character and physiographic expression. They are (1) Rome formation; (2) Conasauga limestone; (3) Cambrian or Ordovician dolomites; (4) Ordovician limestones; (5) Red Mountain formation; (6) Mississippian chert and limestones; (7) Hartselle sandstone; (8) Floyd shale and Parkwood formation; (9) Pottsville formation.

Rome Formation.—The Rome formation crops out along the Helena fault, on the western side of the Cahaba Valley in eastern Jefferson County. This formation is unimportant as an aquifer, as the area of outcrop is small and the water which it yields is small in quantity and poor in quality. A few dug wells obtain

their water from the Rome shales, but none of those examined was satisfactory. Because of the narrowness of the outcrop almost any farm can obtain its water from one of the overlying formations.

Conasauga Formation.—In Jefferson County the Conasauga formation crops out throughout the length of the Birmingham Valley. In places the outcrop is narrow, but in the vicinity of Bessemer it widens to 3 or 4 miles. In the latitude of Birming. ham the formation is composed mainly of thin-bedded coarsely to finely crystalline limestone showing alternate streaks of light and dark gray paralleling the bedding plane. According to Butts. the thickness of the Conasauga formation in Opossum Valley. west of Birmingham, is about 1,900 feet.' In most of Jones and Opossum valleys, which make up the greater Birmingham Valley. the Conasauga formation is folded, and north of Bessemer it dips steeply to the northwest, away from the crest of the Jones Valley anticline. Some shale is present in the formation, mainly as thin partings between limestone layers. Lithologically the Conasauga formation in Jefferson County differs greatly from the formation in the Coosa Valley, to the northeast, where it is composed largely of shale with thin interbedded limestone layers.

Throughout the greater part of Jefferson County the Conasauga is an excellent aquifer. In Birmingham a number of wells ending in this formation have yields of 50 to 100 gallons a minute. Among such wells are that of the Armour Packing Co., which is 310 feet deep and 12 inches in diameter and yields 100 gallons a minute, with a small drawdown; the well of the Tutwiler Hotel, which is located upon the site of a former spring, is 285 feet deep and 8 inches in diameter and pumps 55 gallons a minute; and the well at the First National Bank, which is 622 feet deep and 10 inches in diameter and pumps 100 gallons a minute. As in most other limestone formations, the water contained in the Conasauga is confined to solution channels, whose location can not be predicted by surface examination. Where these channels are present and where they are encountered by drilled wells large yields may be obtained. There are, however, areas in which these solution channels are widely spaced, and such areas do not readily yield water to drilled wells. Such a situation appears to have been encountered by the Grasselli Chemical Co., at Grasselli, where several wells ranging in depth from 150 to 2,000 feet have been drilled. All were unsuccessful in that they failed to

Butts, Charles, op. cit., p. 72.

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It seems unwise to attempt to obtain water from great depths in the Conasauga formation. Most of the successful wells obtain their water from depths of 200 feet or less. The yields are uncertain. It might safely be said that half of the wells drilled in the Conasauga formation will yield 50 gallons of water a minute, or more, and it is probable that small 6-inch wells drilled anywhere upon the outcrop of the formation will yield enough water for domestic use. Doubtless large yields can be obtained if the wells encounter large solution channels, but it is impossible to predict the location of these channels from any type of surface examination.

Some large springs are fed by water contained in the Conasauga formation. Among them are Picket or Spencer Spring, on the outskirts of Bessemer, where two sinks with a maximum explorable depth of 50 feet yield about 400 gallons of water a minute. In 1925 the Alabama Water Service Corporation tested Spencer Spring and found it to yield 450 gallons a minute. After the failure of Hawkins Spring a 12-inch well was drilled 170 feet deep in Spencer Spring. A small crevice was encountered at 45 feet, several crevices between 80 and 86 feet, and a large crevice with mud and gravel at 107 feet. An air-lift pump was installed, and in a test run after a heavy rain the well was found to yield 14,000 gallons a minute, with a 3-foot drawdown.

Hawkins Spring furnished the Bessemer public supplies from 1891 until October 5, 1927, when it suddenly failed. The water issues from a funnel-shaped opening about 20 feet in diameter and 55 feet deep. Before its failure the spring yielded an average of 1,950,000 gallons a day, and in a test run on August 26, 1926, with a maximum pump capacity of 4,769,000 gallons, it had a drawdown of 12 feet. The history of the failure is of some interest. On the night of October 5, 1927, one pump delivering 2,800 gallons a minute had no appreciable effect upon the spring. The pump was shut down at midnight and was again

started at 6 o'clock the next morning. Within a short time the spring basin was emptied, and the suction foot was exposed. The pump was stopped, and shortly thereafter the spring became muddy and so continued for two months. At first the spring basin contained a thick red mud, but toward the end of the second month the water was only slightly milky. Every effort was made to increase the yield by affording a greater drawdown, and to that end the suction foot was lowered 55 feet below the surface, and the spring was pumped for a short time at 6,000 gallons a minute. After two or three hours, however, the suction foot was again exposed and the yield rapidly decreased to about 300 gallons a minute, which has remained constant up to the present time. According to Jerry Mosely, a caretaker at the spring, within a month after the failure some small caving occurred a quarter of a mile northwest of Hawkins Spring. Some weeks later a small spring, flowing about 60 gallons a minute. broke out in an old sink near the north end of the Midfield subdivision, half a mile north of Hawkins Spring. One observer reported that the Hawkins Spring muddled slightly about two weeks before the failure, but this report was not confirmed by other observers.

From these accounts of the happenings at Hawkins Spring it appears that the failure was due to a blocking of the channel above the mouth of the spring and not to the formation of new openings below, for in that event the head at Hawkins Spring would not have remained constant. Probably the preliminary muddying was caused by the loosening of material in the underground channels that fed the spring, and heralded the eventual collapse of the channel. At the time of failure, some time after midnight of October 5, a cave-in occurred in the feeding channel, restricting the passage so that only a fraction of the normal flow could pass. Such a stoppage permitted the head at the spring to remain unchanged. That the stoppage was caused by material not easily washed away is shown by the fact that a drawdown of 55 feet in the Hawkins Spring basin failed to increase the underground current sufficiently to effect the removal of the blocking material. Simultaneous with the stoppage of the feeding passage, other channels appear to have been opened above the spring which permitted the passage of the normal flow to other underground channels. It is noteworthy that no new springs of sufficient size to account for the excess water over the flow of Hawkins Spring have opened. Probably the underground

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drainage system is so complete as to distribute the excess water to a number of smaller springs in such a way that individual increases in flow were not observed. The failure of Hawkins Spring imposed a serious water shortage upon the city of Bessemer and resulted in financial loss to the Alabama Water Service Corporation, which owned the spring. It was necessary to build a pipe line from Birmingham south to Bessemer to supply the city with water.

Cambrian or Ordovician Dolomites .- The Ketona, Copper Ridge, and Chepultepec dolomites crop out in Jones and Opossum valleys in narrow bands which join at the north end of the Birmingham Valley between Trussville and Pinson, forming an area 6 miles in width. They also crop out in that portion of the Cahaba Valley which lies within Jefferson County. In general their outcrops are marked by a porous cherty subsoil, which forms an excellent ground-water reservoir supplying shallow dug wells from the upper portion of the ground-water body. In Birmingham there are several drilled wells of large yield that obtain water from these formations. The Purity Ice Co., at Tenth Avenue and Twenty-sixth Street, has a well 300 feet deep in which the water stands 40 feet below the ground level; an air lift yields 300 gallons a minute, with a small but undetermined drawdown. The Birmingham Ice & Cold Storage Co. has a group of seven wells ranging in depth from 110 to 350 feet, all 12 inches in diameter. Before 1910 there was an old spring issuing at the surface at the site of the present wells which yielded between 600 and 1,800 gallons a minute. After the completion of the wells the spring ceased to flow, and the water that issued from it is now pumped from the wells. In the summer of 1928 three of the seven wells were in operation. Each supplied 250 gallons of water a minute. They operated independently, and apparently their capacity is determined by the capacity of the pumps upon them. That all the wells encounter the same cavities is established by the fact that parts of a drill rope lost in one of the wells were found in each of the others. Doubtless they all penetrate a solution cavity that carries an underground stream of considerable size. The water from these wells is used for cooling. Because of the likelihood of surface pollution it is not safe for human consumption.

The Virginia Bridge Co., in the northern part of Birmingham, has a well 503 feet in depth and 10 inches in diameter. It encountered a cavity at 110 feet which yielded muddy water. At

the present time the well is equipped with an air lift which yields 300 gallons a minute. Removal of muddy water from this well is believed to have caused a small sink near the well, described on page 40.

The yields obtainable from the dolomites appear to be slightly higher than the average of those obtained from the underlying Conasauga formation. This is due probably to the cherty character of the subsoil, which permits rapid recharge, and to the possible presence of larger and more intimately connected solution channels in the dolomite.

Many large springs are fed by solution channels in the Ketona dolomite. Penny Spring, at Mount Pinson, has a yield of about 500 gallons a minute. Moore's Spring, at Bessemer, has a measured yield of 85 gallons a minute coming from the base of the Copper Ridge dolomite at its contact with the Conasauga limestone. The water is used to supply a swimming pool in a small recreation park of the Tennessee Coal, Iron & Railroad Co. Prince Spring, at Jonesboro, has an estimated yield of 200 gallons a minute coming from the Copper Ridge dolomite. The water is used for stock and domestic purposes. In Avondale Park, in the city of Birmingham, are two springs coming from the Ketona dolomite, which dips 15° SE. The yield of one is estimated at 50 gallons a minute and that of the other at 30 gallons a minute. Both of these springs are polluted, and the water is not suitable for drinking. The Caldwell Spring, at Tarrant City, is fed by the Ketona dolomite. It yields between 200 and 300 gallons a minute and is reported to fluctuate with wet and dry seasons.

Large quantities of water are encountered in some of the quarries in the Ketona dolomite, to the north and northeast of Birmingham. The Dolcito quarry, at Tarrant City, has a maximum depth of 108 feet. In the course of the excavation of this quarry a number of solution channels were cut, and the water that formerly flowed through them now collects in the quarry bottom. Two such solution channels have furnished water throughout the life of the quarry. At the present time the water is handled by two pumps; one with a capacity of 1,500 gallons a minute is operated about 4 hours a day and a smaller pump with a capacity of 250 gallons a minute operates continuously. The water is used for boilers and for washing crushed stone, and some of it is filtered and treated for drinking. In the North Birmingham quarry of the Sloss-Sheffield Co. the Ketona dolomite has

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been excavated to a depth of about 100 feet. A small fault plane at the northeast corner of the quarry, 70 feet below the surface, yields a large amount of water. Two smaller springs yield lesser quantities. According to Mr. H. J. Thomas, of the Sloss-Sheffield Co., the average pumpage from the North Birmingham quarry is 1,800 gallons a minute. Of this 1,100 gallons is used by the coke ovens of the by-product plant.

Ordovician Limestones.-The Longview, Newsla, Mosheim, Lenoir, Little Oak, and Chickamauga limestones are all crystalline and contain only a relatively small amount of dolomite. The Chickamauga limestone crops out in small patches in the Birmingham Valley, and the others are confined to that portion of the Cahaba Valley which lies within the eastern part of the county. Within the valleys they are good aquifers and furnish abundant water to both dug and drilled wells. There has been little water development in these limestones in Jefferson County. A well near Leeds, on the dairy farm of D. J. Watkins, is 296 feet in depth. Cavities were encountered at 78 and 100 feet and between 290 and 296 feet. A small gasoline pump yields 50 gallons a minute, with a drawdown of less than 9 feet. Dug wells are widely scattered on the outcrops of these formations, particularly in the valleys. Most of them are shallow, between 20 and 35 feet in depth. As a rule they do not enter the hard rock but are finished in the weathered residual material upon the limestone.

The Ordovician limestones furnish water for several springs. The city of Leeds is supplied by a spring which lies within St. Clair County, just over the County line. It is owned by the Alabama Water Service Corporation and has a tested capacity of 250 to 350 gallons a minute.

These Ordovician limestones are cut by well-developed solution channels, which furnish connecting passages for the circulation of underground water. In Sec. 2, T. 17 S., R. 1 E., the Little Cahaba River flows into a sink and appears about 1,000 feet to the southwest in a spring. When visited on August 6, 1928, the estimated flow above the sink was 500 gallons a minute, and the spring yielded the same quantity of water. The stream was muddy where it entered the sink, but the spring was clear. Apparently there is a large basin in the underground course of the stream in which suspended matter settles out. The temperature of the water entering the sink was 82° F., and that of the spring 62° F., so that a cooling of 20° took place in the course of the

¹ Personal communication.

stream passing underground. An attempt was made to probe both the spring and the sink. A lead weight could not be low-ered more than 30 feet in either opening.

Red Mountain Formation.—The Red Mountain formation in the Birmingham area is composed of shale and sandstone with beds of iron ore and a few calcareous layers. It crops out on both sides of the Birmingham Valley and forms Red Mountain on the east side, which is a conspicuous topographic feature. In the vicinity of Bessemer the formation contains workable ore beds. The outcrop of the ore is marked by a series of head frames of present slope mines and the scars left by the removal of ore by open-cut methods in the early days of iron mining in the district. The Red Mountain formation is not a good aquifer. Several shallow wells have been dug along the crest of Red Mountain which supply small domestic needs. Most of these wells have not been satisfactory. There are a few springs, situated for the most part in ravines and supplied during rainy weather by water that has percolated for a short distance through the subsoil on the formation. Inasmuch as the overlying Fort Payne formation 13 a good aquifer the fact that the Red Mountain formation yields little water is of slight economic importance. In the red-ore mines in the Birmingham district the Red Mountain formation is comparatively dry. Where fractured near the surface some water is encountered in it, but as the clays of the formation are plastic, fractures at depths are usually sealed. In the deeper parts of some of the red-ore mines "bleeders" are encountered which yield small drips of water and which eventually are exhausted. The character of this water and some of the occurrences are described on page 112.

Mississippian Cherts and Limestones.—The water-bearing formations included in the group of Mississippian cherts and limestones are the Fort Payne chert, the Warsaw limestone, the Gasper formation, and the Bangor limestone. The Fort Payne chert has a thickness in Jefferson County ranging from 90 to 200 feet. It is composed of chert and cherty limestone which weather to a porous cavernous subsoil. The Warsaw limestone, which rests upon the Fort Payne, is a coarse crystalline thick-bedded limestone attaining a thickness of 80 or 90 feet. It is not widely distributed, but has been recognized by Butts' at Vans quarry, near Trussville, and in Shades Valley southeast of Bessemer.

¹ Butts, Charles, U. S. Geol. Survey Geol. Atlas, Bessemer-Vandiver folio (No. 221, p. 11, 1922).

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221, p. 11,

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cause of its limited distribution it is not one of the important aquifers of the county. Resting upon the Warsaw is the Gasper formation, which, like the underlying limestone, is of slight areal distribution. Its maximum thickness in Jefferson County is probably 100 feet. It is composed of shale with a few thin interbedded limestone layers and hence is unimportant as a waterbearing formation. It is overlain by the Hartselle, described below, and this is in turn overlain by the Bangor limestone, which attains a maximum thickness, as shown by borings in Shades Valley, of 365 feet. Of these formations the Fort Payne and Bangor are valuable aquifers and the others, because of their meager areal distribution or unfavorable lithologic character, can not be considered important sources for underground water. Between the base of the Fort Payne formation and the top of the Red Mountain formation are the Frog Mountain sandstone and the Chattanooga shale. The Frog Mountain sandstone is variable in thickness and distribution. The overlying Chattanooga shale ranges in thickness from a few inches to 2 feet, and because of its impermeable character and extreme thinness, is not important as a source of ground water.

In Jefferson County there are a number of both drilled and dug wells which obtain their water from the Fort Payne formation. Dug wells usually end in the porous cherty subsoil derived from the weathering of this formation. Usually they are satisfactory, and such a well located anywhere upon the outcrop of the formation is fairly certain to yield adequate water for domestic use in the average household. No data were obtainable for drilled wells with large pumping equipment.

The Bangor formation, where it crops out in the valleys, can also be depended upon to yield ground water. As in the Fort Payne formation, dug wells in the Bangor seldom penetrate unweathered rock but end in subsoil derived from the weathering of the limestone. Most of these wells are fairly satisfactory. At Trussville there are many drilled wells deriving water from the Bangor. These range in depth between 57 and 150 feet. Most of them are provided with small electric deep-well pumps whose capacities are 10 or 15 gallons a minute. All these wells are reported as satisfactory. It is probable that both the Fort Payne formation and the Bangor limestone can be depended upon to yield domestic water supplies throughout the extent of their outcrop. Larger yields will be obtained only from wells penetrating large solution channels. Undoubtedly such channels are abun-

dant, but intercepting them, as in most limestones, is a matter of chance. Both the Fort Payne and the Bangor limestones supply many springs, which yield as much as 50 or 60 gallons a minute.

Hartselle Sandstone.—The Hartselle sandstone crops out on the east side of the Birmingham Valley north of Bessemer, attaining a maximum thickness in the vicinity of Irondale of 117 feet. It is variable in character, ranging from a hard, almost quartzitic sandstone to a coarse, loosely cemented and friable sandstone.

Its water-bearing character appears to depend upon the degree of cementation of the sand grains. Where friable, as at Gate City, it readily permits the passage of ground water and supplies wells. Where tightly cemented it is likely to be dry. In the vicinity of Gate City, northeast of Birmingham, are four flowing wells reported to be 25, 85, 103, and 344 feet deep. These wells are down the dip from the outcrop of the Hartselle sandstone, and it is probable that the water yielded by them is furnished by this formation. When visited by the writer in July. 1928, these wells had just been cleaned, and their flows ranged from 50 to 100 gallons a minute each. Similar artesian wells might possibly be developed on the east side of the Hartselle ridge in Shades Valley. An artesian well originally drilled in exploration for iron ore is used as a domestic supply for the mining camp of Ishkooda. The well is at Grace's station and is reported to be about 1,800 feet deep. At present its flow is 50 gallons a minute, which is believed to come from the Hartselle sandstone.

Floyd Shale and Parkwood Formation.—The Floyd shale and Parkwood formation crop out on both sides of the Birmingham Valley and on the east side of the Cahaba Valley east of Leeds. The Floyd shale is composed of brown to gray-green soft crumpling shale with a few thin interbedded layers of limestone and some sandstone. The overlying Parkwood formation is likewise composed mainly of shale, but it contains a large amount of arkosic sandstone, and the shale is on the whole probably less friable. The thickness of the Floyd ranges from 1,000 to 1,200 feet, and the Parkwood probably has a maximum thickness of 2,200 feet. These formations are poor aquifers, and the water yielded by them is uncertain in both quantity and quality.

There are many dug wells in Jefferson County in the Floyd shale. These have an average depth of 25 feet. About half of

¹ Smith, E. A., The underground water resources of Alabama, p. 87, Alabama Geol. Survey, 1907.

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the dug wells for which records were obtained report failure in dry seasons, and all the wells have small yields. When emptied they fill very slowly, so that unusual demands for water are not readily met by the average domestic dug well. There are a few shallow drilled wells with depths between 50 and 100 feet. One such well penetrated a limestone layer and furnished good and adequate water. Usually, however, the yields of drilled wells are much smaller than those of dug wells. Hall's Spring, on the southwest slope of Red Mountain in the latitude of Bessemer, has a yield of 25 gallons a minute. This is unusual for the Floyd shale, and it is probable that the spring derives its water from an unusually thick limestone bed within the shale. There are many small seepage springs on the outcrop of the Floyd shale in Shades Valley, but few of them yield more than half a gallon to 1 gallon a minute.

In its water-bearing character the Parkwood formation closely resembles the Floyd shale in that it yields to domestic dug wells only small quantities of water, often of poor quality. Many of these wells report failure in dry seasons, and all report a very slow inflow from the shale. A few springs, situated for the most part in ravines, are fed by seep water and yield a gallon or two of water a minute after a heavy rain. In July, 1928, the writer visited a well at Roper that was being drilled to supply the railroad water tank. A standard rig had penetrated the Parkwood to a depth of 420 feet without encountering water. It is unlikely that large domestic supplies can be obtained from this formation; certainly it will not yield sufficient water for industrial uses.

Pottsville Formation.—Over one-half of the area of Jefferson County is occupied by the outcrop of the Pottsville formation. West of the Birmingham Valley is the Warrior coal field, and between the Birmingham and Cahaba valleys is the Cahaba coal field. In both the Pottsville formation is exposed at the surface. The thickness of this formation in the Warrior field is about 2,300 feet, and the Cahaba field about 5,500 feet. Shale predominates, and interbedded with it is sandstone, more or less arkosic, of variable thickness. Many of the sandstone beds are prominent ridge-makers, and a number have received names. Butts' has described the Pottsville formation in detail. In the Warrior coal field he recognizes three sandstone members, in as-

¹ Butts, Charles, U. S. Geol. Survey Geol. Atlas. Birmingham folio (No. 175, pp. 8-9 1910; Bessemer-Vandiver folio (No. 221), pp. 14-15, 1927; Geology of Alabama; Alabama Geol Survey Special Rept. 14, pp. 208-213, 1926.

cending order—the Boyles sandstone member, the Camp Branch sandstone member, and the Razburg sandstone member; and in the Cahaba coal field the sandstone of Little Shades Mountain, the sandstone of Buff Ridge, the sandstone of Bee Ridge, the Shades sandstone member, the Pine sandstone member, the Chestnut sandstone member, the Rocky Ridge sandstone member, and the Straven conglomerate member. Interbedded in the sandstone and shale of the Pottsville are many coal beds, not all of which, however, are of sufficient thickness to be of economic importance.

Ground water is widely distributed in the Pottsville formation of Jefferson County, but the yields obtainable are small. Both dug and drilled wells are used for domestic supply. The average dug well is less than 30 feet in depth, and domestic drilled wells are usually less than 100 feet deep. The quality of the water obtained from drilled wells is generally good. Occasionally iron is encountered in sufficient quantities to stain cooking utensils and to render the water unsuitable for laundry use. Some hydrogen sulphide also occurs in the water, but generally not in sufficient quantities to make the water unpalatable. It can usually be removed by aeration. There are several wells drilled in the Pottsville, ranging in depth from 50 to 800 feet. which are provided with power pumps. The yields of these wells are relatively small, the maximum being 30 gallons a minute, obtained from the well of Mrs. M. T. Huff, in Sec. 36, T. 18 S., R. 3 W. In some of the coal-mining towns difficulty is encountered in keeping mine water from entering the general ground-water circulation and appearing in the wells. When this occurs the well water is acid and contains large amounts of iron.

An artesian well in Sec. 16, T. 14 S., R. 3 W., was visited by the writer. No reliable data on the history of the well could be obtained, but local residents reported it to be 300 feet in depth. On August 18, it was flowing 15 gallons a minute, and the water had a temperature of 62.5° Fahrenheit. It had a slight hydrogen sulphide odor, which was not unduly objectionable.

There are many springs situated in ravines in the Warrior and Cahaba coal fields. Of the 10 listed in the spring table, the maximum yield is 15 gallons a minute, and the average 5 gallons a minute. Many springs that are not tabulated were observed. Their flow was between 1 and 2 gallons a minute. These springs are fed by water that seeps from the hillside in the loose and unconsolidated residual material derived from the weather-

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Varrior g table, e 5 galere ob-These ne loose eathering of the Pottsville formation, and it is probable that the water issuing from these springs has not descended to any great depth in the formation. Fulton Springs, in Sec. 25, T. 16 S., R. 3 W., has a yield which fluctuates between 5 and 10 gallons a minute, depending upon local rains. The water is caught in an excavated basin 10 feet square and 10 feet deep and is bottled and sold as Fulton Spring water. Another commercial water is obtained from the Allbritton Spring, in sec. 17, T. 14 S., R. 3 W. Here a sunken tile, 3 feet in diameter, serves to collect the water, which flows at the rate of approximately 4 gallons a minute. It has a slight hydrogen sulphide odor, and a small amount is marketed in Birmingham.

It is improbable that large yields can be obtained from wells drilled in the Pottsville formation in Jefferson County. Probably 25 gallons a minute for an 8-inch well is the maximum that can reasonably be expected.

Analyses of waters from Jefferson County

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Nitrate radicle (NO.)		4.6	38.		2.5		.62	
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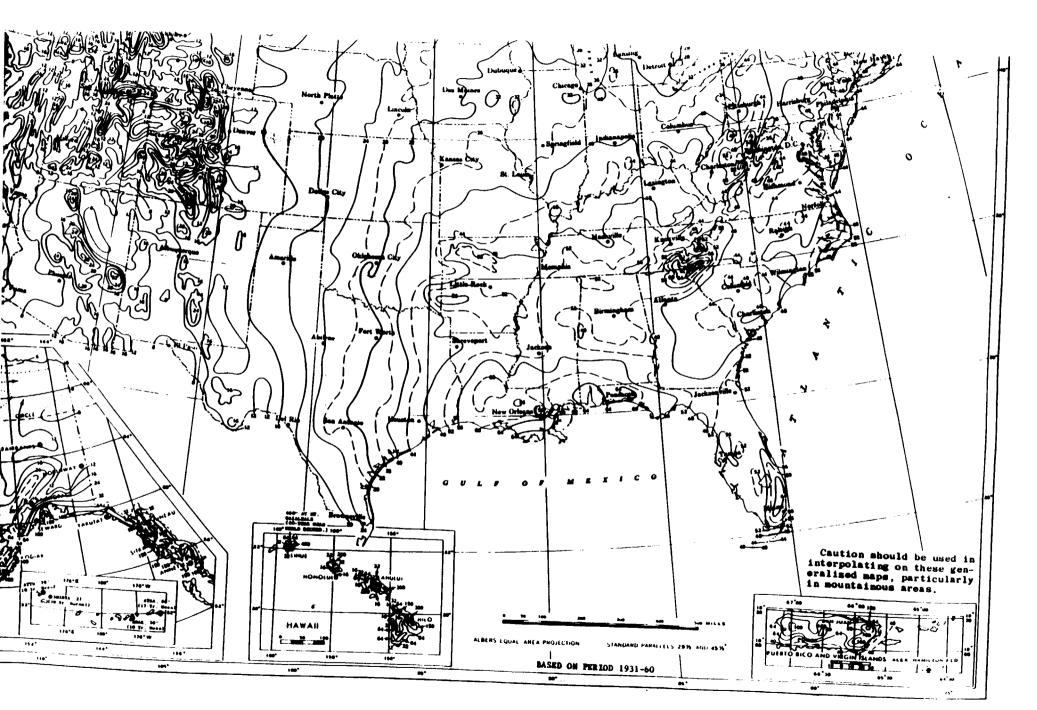
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ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION Robert M. White, Administrator

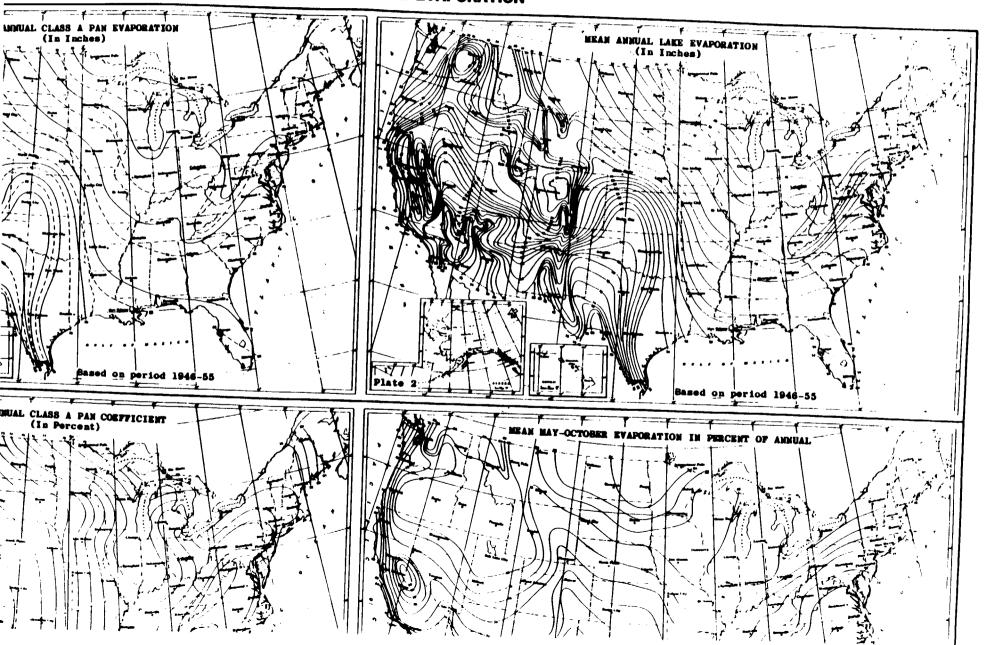
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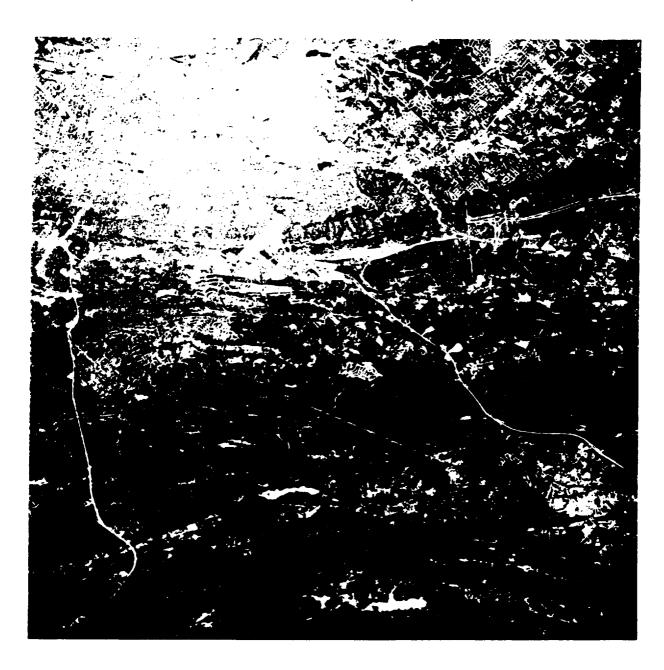
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1983



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AREAL GEOLOGY OF JEFFERSON COUNTY, ALABAMA



GEOLOGICAL SURVEY OF ALABAMA

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Thomas J. Joiner State Geologist

GEOLOGIC DIVISION Charles W. Copeland, Jr. Chief Geologist

ATLAS 15

AREAL GEOLOGY OF JEFFERSON COUNTY, ALABAMA

By Jack T. Kidd

with a section on LINEAMENTS By Karen E. Richter

This atlas was compiled and published as part of a cooperative program by Jefferson County; the cities of Birmingham, Homewood, Gardendale, and Pleasant Grove; U.S. Geological Survey; and Geological Survey of Alabama.

University, Alabama 1979

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May 16, 1979

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Honorable Fob James Governor of Alabama Montgomery, Alabama

Dear Governor James:

I hereby transmit a report entitled "Areal Geology of Jefferson County, Alabama" by Jack T. Kidd, with a section on "Lineaments" by Karen E. Richter, which has been published as Atlas 15 of the Geological Survey of Alabama.

This is one of several reports resulting from geologic and hydrologic studies in Jefferson County. Information on areal geology presented in this report supplements previous Geological Survey reports on the Birmingham-Jefferson County area. The geologic data are expected to find application in planning of sanitation facilities, water resource development and construction engineering.

This report was made possible through the cooperative efforts of Jefferson County, the city of Birmingham, city of Homewood, city of Gardendale, city of Plessant Grove, U.S. Geological Survey, and Geological Survey of Alabama.

Respectfully,

Thomas J. Joiner State Geologist 9.وردنج∞ رث

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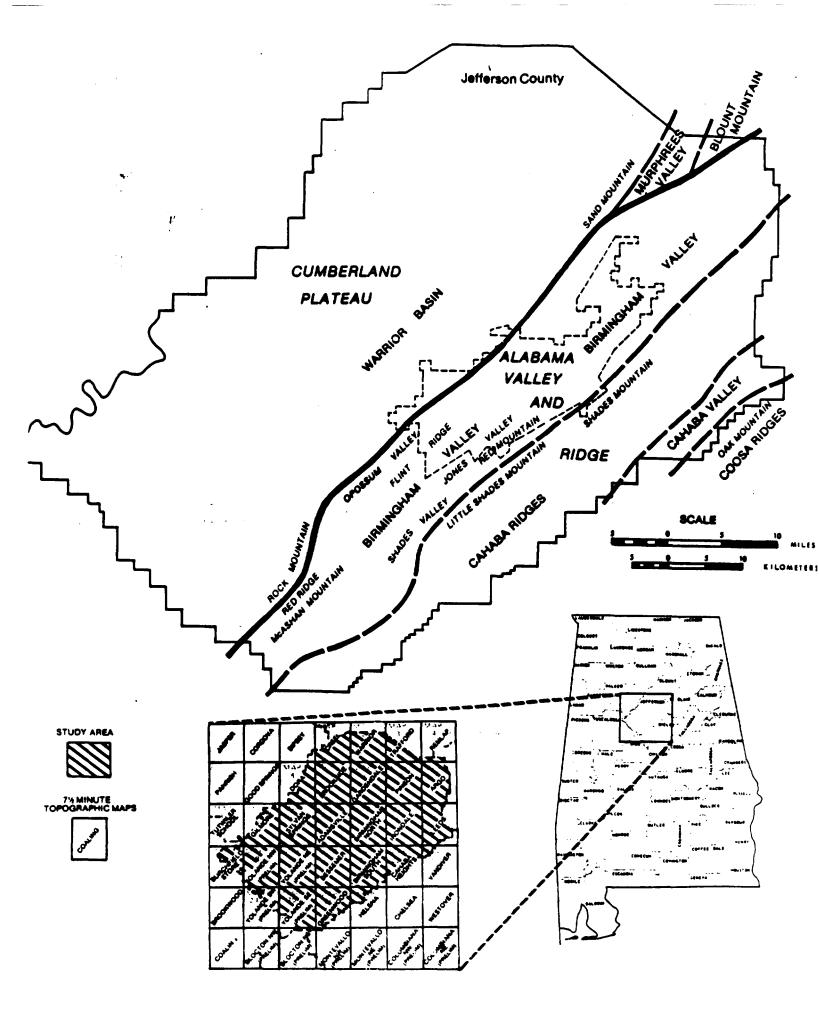


Figure 1,-Physiographic features of Jefferson County, Alabama, and index map of quadrangles in study area.

AREAL SEVEN TEJEFFERSON COUNTY, ALABAMA

By Jick T. Kidd

with a section on LINEAMENTS

By Karen E. Richter

ABSTRACT

The Cumberland Plateau and Valley and Ridge physiographic sections in Jefferson County are underlain by more than 10,000 feet of sedimentary rocks that range in age from Cambrian to Holocene. This area includes the Warrior Basin of the Cumbirland Plateau and the Birmingham anticlinorium, Cahaba synclinorium, and the western edge of the Coosa synclinorium of the Valley and Ridge. The Warrior Basin is underlain by gently dipping rocks of the Pottsville Formation and is characterized by northwest-oriented normal faults. The Valley and Ridge section is characterized by northeast-oriented folds and thrust faults. Areal geology is presented on 7½-minute topographic maps at a scale of 1:48,000. Specific data on each structural feature are presented in table form.

INTRODUCTION

This atlas includes geologic maps of Jefferson County and brief descriptions of the rock types present. Structural features presented include faults, folds, and major lineaments observed on recent earth satellite and aerial imagery (maps 1-29; appendices A and B).

Areal geology and structural features are presented on 7½-minute topographic quadrangle maps at a scale of 1.48,000. Data presented on these maps and in the appendices have been compiled from published and unpublished reports and maps, office studies, and field observations. Juch of the data presented in this atlas have been adapted from Kidd and Shannon (1977). The maps and appendices are considered preliminary and subject to future revision as the Geological Survey acquires more data. The Pottsville Formation in Jefferson County has been treated as one unit in this report. Known faults and strike and dip symbols have been added to the geologic maps to indicate the general inclination of the beds,

Jefferson County is covered by 31 7½-minute topographic quadrangle maps (fig. 1). This study, however, does not include the Sipsey, Goodsprings, Montevallo NW, and Blocton NE quadrangles, as their combined coverage of Jefferson County is less than 4 square miles.

ACKNOWLEDGMENTS

The author gratefully acknowledges the numerous individuals who assisted the investigation. The following provided information or access to information on the geology of Jefferson County—H. T. Williams, Chief, Division of Safety and Inspection, Department of Industrial Relations; the late Dr. George F. Brockman, University of Alabama in Birmingham; United States Steel Corporation; Robert Carr, Black Diamond Coal Company; and Thomas A. Simpson and Dr. William G. Hooks, University of Alabama. Special acknowledgment is given to Samuel W. Shannon of the Alabama Highway Department who contributed much of the original work (Kidd and Shannon, 1977) utilized in this report.

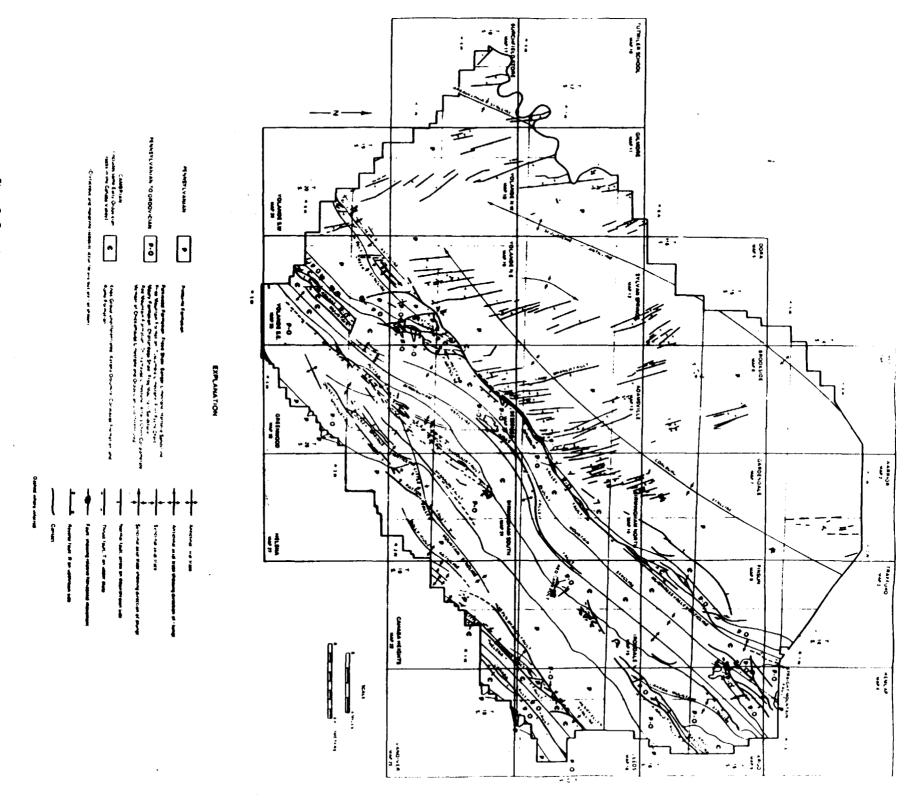
PREVIOUS INVESTIGATIONS

McCalley (1898) mapped the outcropping coal seams in the Warrior Basin, including western Jefferson County. The outcrop patterns of the coal seams clearly indicate the major structural features of the area, including the Sequatonie and Blue Creek anticlines, the Coalburg and Blue Creek syncines, and the Valley and Ridge structural front located along the western limb of the Birmingham anticlinorium. Charles Butts has published more on the geology of Jefferson County than perhaps any other individual. Butts (1907) mapped numerous structural features and coal seams in the eastern part of the county in the Cahaba coal field. Burchard and Butts (1910) studied the iron ores, fuels, and fluxes in the Birmingham area and included a geologic map of the Birmingham Valley. One of the most comprehensive geologic investigations in the Birmingham area was by Butts (1910). A general discussion of numerous geologic exposures in Jefferson County is given in "The Paleozoic rocks" (Butts, 1926). Butts discussed the paleontology, structure, and distribution of Paleozoic rock units throughout north Alabama, including Jefferson County. A description of the geology in the southeastern part of the county is included in "Bessemer and Vandiver quadrangles" by Butts (1927).

Numerous structural features were mapped by Semmes (1929) in Jefferson County, Hooks (1961) and Vernon (1937) mapped parts of the southern portion of Birmingham Valley, including the structurally complex areas of McAshan and West Rock Mountains, Simpson (1965) mapped a part of southeast Jefferson County and illustrated the relationships between surface and subsurface structural features in the south-central part of Jefferson County where data have been obtained from outcrops and iron ore mines. Thomas (1972) described the Mississippian rock units in the county. Self, Neathery, and Jacks (1975) compiled a map on the structural features of Alabama, including Jefferson County, and discussed the characteristics of the major named features. A recent investigation of the Valley and Ridge province in Jefferson County by Kidd and Shannon (1977) presented areal geologic maps with modifications from previously published reports. In addition to the above, a number of published and unpublished reports, theses, dissertations, and maps contain data on the geology of Jefferson County and are referenced in this report.

PHYSIOGRAPHIC SETTING

Jefferson County is located in the southernmost extensions of the Appalachian Valley and Ridge and the Appalachian Plateaus physiographic provinces. The southeastern part of Jefferson County lies in the Alabama Valley and Ridge section of the Appalachian Valley and Ridge province, and the northwestern part of the county lies in the Cumberland Plateau section of the Appalachian Plateaus province.



and index of geologic quadrangle maps

The Alabama Valley and Ridge section consists of northeast-southwest-trending valleys and ridges and notudes Birmingham Valley, Cahaba Ridges, Cahaba Valley, and Coosa Ridges. The Cumberland Plateau section is characteristically a dissected plateau of moderate relief and includes the Warrior Basin and the southern extension of Murphrees Valley and Blount Mountain (Sapp and Emplaincourt, 1975).

The Birmingham Valley is approximately 45 miles long and ranges from 3 to 7 miles in width. It extends from near the Jefferson St. Clair County boundary in the northeast to near the Tuscaloosa-Bibb-Jefferson County boundaries to the southwest. The southwestern end of the valley is obscured by Coastal Plain sediments south of the Bucksville area, and the northeastern end of the valley merges with Sig Canoe Valley in western St. Clair County, Birmingham Valley is bounded on the northwest by an escarpment formed by the Pottsville Formation. This escarpment includes Rock Mountain along the southwestern edge of the valley and Sand Mountain along the northwestern edge. The northern part of Birmingham Valley is bounded by the southwestern extensions of Murphrees Valley and Blount Mountain and merges with Big Canoe Valley in St. Clair County. The southeastern side of Birmingham Valley is bounded by escarpments formed by the Parkwood and Pottsville Formations. These escarpments are known locally as Shades and Little Shades Mountains, The central part of the Birmingham Valley is separated into two smaller valleys by Flint Ridge. Opossum Valley lies to the west of Flint Ridge and Jones Valley to the east.

Red Mountain, which is located along the eastern side of the Birmingham Valley, is a narrow prominent ridge that trends northeast-southwest and separates Shades Valley on the southeast from Jones Valley on the northwest. Red Mountain is so named for the characteristic red soil and rocks of the iron-bearing Red Mountain Formation which crops out along the crest.

The Cahaba Ridges are located in eastern Jefferson County between Birmingham and Cahaba Valleys. The Cahaba Ridges consist of a group of parallel, linear, northeast-southwest-trending ridges and valleys formed by the sand-stones and shales of the Pottsville and Parkwood Formations.

Cahaba Valley is located between the Cahaba Ridges to the northwest and the Coosa Ridges to the southeast. Cahaba Valley in Jefferson County is about 10 miles long and 2 to 3 miles wide. The valley is underlain predominantly by non-resistant carbonate and shale beds that are generally highly folded and faulted. The Cahaba Valley-Cahaba Ridges boundary is marked by the Helena fault and a long, narrow valley developed upon the shales of the Rome Formation.

The Cahaba Valley is bounded on the southeast by the Coosa Ridges, which consist of northeast-southwest-trending, subparallel ridges and valleys formed by sandstones and shales of the Pottsville and Parkwood Formations. In Jefferson County, the Coosa Ridges are bounded on the northwest by Oak Mountain, a prominent escarpment overlooking the Cahaba Valley.

The Cumberland Plateau section in northern and western Jefferson County consists of Blount Mountain, Murphrees Valley, and the Warrior Basin. Blount Mountain is a prominent steep-sided dissected plateau underlain by gently dipping beds of the Pottsville Formation. In Jefferson County, Blount Mountain is bounded on the south and southeast by Birmingham Valley and on the west by Murphrees Valley. Murphrees Valley is a faulted anticlinal valley that contains inner valleys and ridges. Murphrees Valley is bounded on the west by the Warrior Basin and merges with Birmingham Valley to the south. The Warrior Basin is a broad dissected upland developed upon gently dipping beds of the Pottsville Formation.

GENERAL GEOLOGY

Jefferson County is underlain by more than 10,000 feet of sedimentary rocks (table 1) that are generally flat-lying in the northwest and folded and faulted in the southeast. The flat-lying rocks of the Warrior Basin in northwestern Jefferson County are separated from the faulted and folded rocks of the Valley and Ridge in southeastern Jefferson County by the Appalachian structural front, a tectonic zone located along the northwestern edge of the Birmingham Valley.

Exposures of bedrock in Jefferson County range in age from Cambrian to Pennsylvanian (fig. 2). Mixed carbonate and clastic rocks of Cambrian age are generally exposed along the axes of the eroded anticlines and adjacent to the major thrust faults. Rocks ranging in age from Cambrian to Mississippian, including clastic and carbonate formations, occur along the flanks of the anticlines, and resistant sandstones and shales of Pennsylvanian age underlie the Warrior Basin and cap the higher ridges in the county, Sand, clay, and gravel deposits of Late Cretaceous age occur as outliers near the boundaries with Tuscaloosa and Bibb Counties, Unconsolidated alluvial deposits of Quaternary age, composed mainly of clay, sand and gravel, occur along and generally parallel to the streams and rivers in the area and as isolated terrace deposits in areas away from the present streams. These latter deposits were formed when beds of ancestral streams in the area were at higher elevations than today's streams,

CAMBRIAN

ROME FORMATION

The Rome Formation is about 500 feet thick and consists of greenish-gray and grayish-red shale with rare thin beds of argillaceous limestone, chert and sandstone. The Rome crops out only in the Cahaba Valley in a thin belt adjacent to the Helena thrust fault.

CONASAUGA FORMATION

The Conasauga Formation consists of thin-bedded, dark- to brownish-gray sublithographic limestone, light-olive to medium-gray shale, and brownish-gray dolomite. Chert locally occurs in the residuum as thin prismatic fragments. The Conasauga is estimated to be 1,100 to 1,900 feet thick and occurs throughout Jones and Opossum Valleys but is absent in the Cahaba Valley (Butts, 1910).

KETONA DOLOMITE

The Ketona consists of 400 to 600 feet of relatively pure chert-free light-brownish-gray to yellowish-gray crystal-line thick-bedded dolomite with lesser amounts of brownish-gray dolomite occurring near the contact with the underlying Conasauga Formation. The Ketona is present throughout the Cahaba and Opossum Valleys and Jones Valley north of McCalla; south of the McCalla area, the Ketona is absent.

CAMBRIAN AND ORDOVICIAN

KNOX GROUP UNDIFFERENTIATED

The Knox Group consists of medium- to light-gray thick-bedded cherty dolomite with lesser amounts of lime-stone and dolomitic limestone. The Knox generally weathers to irregular boulders and fragments of light-gray to grayish-pink chert and is generally unfossiliferous, although cryptozoans and gastropods occur locally. The Knox occurs throughout Jones, Opossum, and Cahaba Valleys and is estimated to be approximately 2,000 feet thick in the Birming-

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Table 1 - Generalizado - Impiriz or jeologic formations in Jefferson County, Alabema.

ham area (Butts, 1926). At Tannehill near the southern part of the county, the Knox is estimated to be approximately 1,500 feet thick (Hooks, 1961). In Cahaba Valley in the southeastern part of the county and in Murphrees Valley near the northeastern county boundary, the Knox is 3,000 feet thick or greater (Butts, 1910). The Knox consists predominantly of the Copper Ridge Dolomite in the Birmingham area. In the Cahaba Valley, the Knox Group consists of, in ascending order, the Copper Ridge Dolomite, Chepultepec Dolomite, Longview Limestone and Newala Limestone. The Copper Ridge and Chepultepec are mapped as Knox Group undifferentiated, and the Longview and Newala are mapped with the overlying Ordovician undifferentiated.

ORDOVICIAN

ORDOVICIAN UNDIFFERENTIATED

This unit includes rocks in the subsurface in the Warrior Basin in western Jefferson County and rocks exposed in Cahabe Valley in eastern Jefferson County. The Ordovician undifferentiated rocks in the Warrior Basin are equivalent in part to the Chickamauga Limestone of Birmingham Valley and the Stones River, Nashville, Eden, Maysville, and Richmond Groups of north Alabama and Tennessee. The Ordovician undifferentiated in the Warrior Basin consists predominantly of 700 to 800 feet of brownish- to light-gray sublithographic to crystalline limestone. The upper and lower parts of the unit locally grade into calcareous sandstone. In Cahaba Valley, the Ordovician undifferentiated consists of approximately 2,300 to 2,600 feet of medium-bedded light- to darkto very dark-gray sublithographic to very coarsely crystalline limestone that is fossiliferous and (or) cherty in part. This interval has been subdivided by some previous authors into as many as five separate formations based on color, fossil content, and chert content. Because of the lack of exposures of these rocks, maps in this atlas indicate these rocks as one lithologic unit. The lower part of this unit includes the undifferentiated Newsla Limestone and Longview Limestone of the upper part of the Knox Group.

ATTALLA CHERT CONGLOMERATE MEMBER: CHICKAMAUGA LIMESTONE

The Attalla Chert Conglomerate Member at the base of the Chickemauga Limestone occurs in scattered areas in the region, primarily in Jones Valley, and consists of two lithofacies: a light-gray to light-brownish-gray very coarse-grained, angular chert and quartz sandstone; and a reddish-orange conglomerate composed of well-rounded chert clasts up to 12 inches in diameter in a mateix of finer grained, angular to subrounded chert fragments. These two lithofacies are locally gradational, as at Ward Park in Green Springs, but the two types are generally segregated. Bedding features are generally absent, but exposures along Five Mile Creek in the SW corner of sec. 25, T. 16 S., R. 2 W., show well-developed graded bedding and cross bedding. Where present, the average thickness of the Attalla is about 20 feet and the maximum thickness is 50 feet.

CHICKAMAUGA LIMESTONE

The Chickamauga Limestone consists of 200 to 500 feet of thin- to medium-bedded sublithographic fossiliferous iimestone and includes some argillaceous and crystalline limestone, shale and rare bentonite interbeds. The limestone is reddish- to greenish-gray near the base, but the remainder is light-gray to bluish-gray. Bryozoans, brachiopods, and corals are the most abundant fossils in the formation. The best exposures in the county are in the abandoned guarries on Red

Mountain adjacent to Gate City. The Chickamauga does not occur in the Cahaba Valley, but the upper part of the Ordovician undifferentiated may be a time equivalent.

SEQUATCHIE FORMATION

The Sequatchie Formation in Jefferson County is exposed in the Red Mountain Expressway Cut where it consists of 0 to 2.5 feet of moderate-red to yellowish-gray and moderate-pink to dusky-red mottled fossiliferous limestone that contains pink, yellow, and green calcite grains. The limestone contains interbedded grayish-red siltstone up to 1 foot in thickness. The Sequatchie may extend into the subsurface of the Warrior Basin in northern Jefferson County but is absent south of the Birmingham area and in the Cahaba Ridges and Cahaba Valley (Drahovzal and Neathery, 1971).

SILURIAN

RED MOUNTAIN FORMATION AND SILURIAN UNDIFFERENTIATED

The Red Mountain Formation and the Silurian undifferentiated consist of dark-reddish-brown to olive-gray siltstone, sandstone, and shale; olive-gray to grayish-pink limestone; and hematite beds 5 to 30 feet thick. The limestone occurs predominantly in the southern part of the Birmingham Valley and in the subsurface of the Warrior Basin. The Red Mountain Formation as defined in this atlas includes all Silurian rocks in Jefferson County southeast of the Warrior Basin. The Silurian undifferentiated includes rocks in the subsurface of the Warrior Basin in Jefferson County equivalent to the Red Mountain Formation of southeastern Jefferson County and the Wayne Group and Brassfield Limestone of north Alabama. In the southeastern part of the county, the Red Mountain Formation crops out in a fault block along the southeastern boundary of the Cahaba Ridges adjacent to the Helena fault. Southeast of the Helena fault the Rad Mountain is absent. The Red Mountain Formation and the Silurian undifferentiated are 200 to 500 feet thick in the Birmingham Valley and in the subsurface of the Warrior Basin, The Red Mountain is approximately 350 feet thick or less in the subsurface of the Cahaba Ridges on the basis of exposures on the southeast limb of the Birmingham anticline.

DEVONIAN

DEVONIAN UNDIFFERENTIATED

One hundred twenty feet of Devonian undifferentiated rocks have been penetrated in an oil-and-gas test well in the southwestern part of Jefferson County. The Devonian undifferentiated rocks consist of light-olive-gray to white to yellowish-gray finely crystalline siliceous, cherty, glauconitic, dolomitic limestone. The limestone contains brachiopods and possible chitinozoans. The Devonian undifferentiated rocks are overlain by the Chattanooga Shale and underlain by Silurian undifferentiated rocks. The relationship of the subsurface Devonian undifferentiated rocks of the Warrior Basin to the Devonian Frog Mountain Sandstone of the Valley and Ridge province is uncertain.

FROG MOUNTAIN SANDSTONE

The Frog Mountain Sandstone is older than the Chattanooga Shale and consists of medium- to thick-bedded duskyred and light- to dark-gray coarse-grained hematitic sandstone and light- to dark-gray hematitic sandstone and pebble conglomerate. Small amounts of chert and shale occur locally. The Frog Mountain occurs throughout most of the southeastern part of Jefferson County but is absent in the western, northern, and northeastern parts of the county. Measured sections in Birmingham and Cahaba Valleys indicate the formation is 0 to 36 feet thick. An isopach map of the Frog Mountain indicates an anomalous thickening in southern Jefferson, eastern Tuscaloosa, and northern Bibb Counties where the formation may be greater than 40 feet in thickness (Kiefer, 1970).

CHATTANOOGA SHALE

Typical Chattanooga Shale consists of brownish-black silty fissile shale and locally may include thin beds of sand-stone. Only one outcrop of the typical Chattanooga was observed in Jefferson County; 10 feet or more of brownish-black shale crops out in the stream bed of Valley Creek near West Rock Mountain. In Cahaba Valley, the Chattanooga crops out approximately 0.5 mile east of Leeds and consists of 2 feet of purple shale (Butts, 1910). In the subsurface of the Warrior Basin, the Chattanooga consists of 5 to 15 feet of brownish-black silty, pyritic, carbonaceous shale that grades into fine-grained quartzose sandstone.

MISSISSIPPIAN

MAURY FORMATION, FORT PAYNE CHERT, AND TUSCUMBIA LIMESTONE

The Maury Formation is overlain by the Fort Payne Chert and consists of 1 to 3 feet of greenish-gray to grayishred thinly laminated shale that commonly contains phosphate nodules. The Maury occurs sporadically throughout the Birmingham area and, because of its limited thickness, is mapped with the overlying Fort Payne and Tuscumbia. The Fort Payne Chert in most exposures is highly weathered and consists of 90 to 200 feet of grayish-orange to light-gray bedded fossiliferous chert. In the northern part of the county, unweathered Fort Payne Chert consists of dark-gray sublithographic limestone and dense dark-gray chert. Chert beds in the Fort Payne are distinct; they range in thickness from a few inches to 2 feet and have irregular to smooth bedding surfaces that are commonly separated by thin shaly zones. The most characteristic fossils are crinoid columnals, brachiopods, and corais.

The Tuscumbia Limestone overlies the Fort Payne Chert and consists of thick-bedded medium-dark- to medium-gray crystalline, colitic, sublithographic and bioclastic limestone that locally contains minor amounts of chert. Reported thicknesses of the Tuscumbia in the Birmingham Valley range from 80 feet at Vann's Quarry near Trussville (Butts, 1926) to approximately 70 feet in the subsurface in the Greenwood area (Newton, Copeland, and Scarbrough, 1973). In the subsurface on the southeastern edge of the Warrior Basin and in the subsurface near the Birmingham Valley-Cahaba Ridges boundary, the Tuscumbia is approximately 110 feet thick. The Tuscumbia does not occur in the Cahaba Valley and is rarely exposed in the Birmingham area; it has been included on the maps with the Fort Payne Chert and the Maury Formation.

PRIDE MOUNTAIN FORMATION

The Pride Mountain Formation consists of 120-420 feet of dark-gray fissile clay shale, locally occurring thin beds of siltstone or fine-grained quartzose sandstone, and a besal bed of oolitic limestone up to 8 feet in thickness. Siderite nodules and marine invertebrate fossils are common at some localities. The formation is generally poorly exposed, however, good exposures can be seen at Vann's Quarry north of Trussville. Where the Hartselle Sandstone is absent, the

Pride Mountain Formation is indistinguishable from the Floyd Shale and is mapped as a part of that unit.

HARTSELLE SANDSTONE

The Hartselle Sandstone is composed mainly of clean, well-sorted light-colored very fine- to medium-grained cross-bedded quartz sandstone which weathers to a sandy soil. Two main lithofacies are present in Jefferson County; a medium- to very thick-bedded fine- to medium-grained orthoquartzite is predominant in the Birmingham Valley, and a mainly thin- to medium-bedded very fine- to fine-grained partly argillaceous sandstone occurs in the Cahaba Valley. The Hartselle thins to the southwest in both valleys and is absent near the county boundary. Where present, the Hartselle is as much as 120 feet thick.

BANGOR LIMESTONE

The Bangor Limestone consists of medium-to medium-light-gray medium-bedded primarily bioclastic or colitic limestone. Beds of argillaceous and sublithographic limestone and shale occur locally. The Bangor is more than 500 feet thick in the northern part of the county (Thomas, 1972), thins to the south, and is absent in the southern part of the county. The Bangor is not exposed in the Cahaba Valley. Outcrops rarely exceed 150 feet in thickness as the formation readily weathers to a dark-brown soil. The best exposures in the county are in the abandoned quarries 1 mile southwest of Trussville and along the railroad track at the northeast end of Norris Railroad Yards in Irondale.

FLOYD SHALE

The Floyd Shale consists of dark-gray clay shale which locally contains thin beds of siltstone. Outcrops are rare as the Floyd readily weathers to a brown or light-gray massive clay. Floyd Shale has been extensively mined for use in the ceramic industry 2 miles west of Greenwood and at Leeds. The formation is 0 to 600 feet thick in Birmingham Valley and in the subsurface of the Warrior Basin. In the Cahaba Valley and in the subsurface of the Cahaba Ridges, the Floyd is 300 to 1,000 feet thick.

MISSISSIPPIAN AND PENNSYLVANIAN

PARKWOOD FORMATION

The Parkwood Formation is composed of interbedded sandstone, shale and mudstone. The sandstone is light to medium gray, very fine to fine grained, argillaceous, micaceous, and locally cross bedded and ripple marked. Sandstone beds range from less than 1 inch to 6 feet in thickness. Upon weathering, the sandstones become reddish-brown and commonly exhibit spheroidal weathering. Shales and mudstones in the Parkwood are medium to dark gray and commonly micaceous. Shale beds range from thin and fissile to massive, and generally weather brownish gray. The Parkwood is absent in the subsurface in the northwestern part of the county and thickens to a maximum of approximately 2,600 feet in the Cahaba Valley in the southeastern part of Jefferson County (Thomas, 1972).

PENNSYLVANIAN

POTTSVILLE FORMATION

The Pottsville Formation consists of alternating beds of sandstone and shale with numerous coal seams and associated beds of underclay. Sandstones near the base of the formation

consist predominantly of orthoquartzites with locally occurring beds of quartz pebble conglomerate. Sandstones in the upper part of the formation are generally subgraywackes composed of quartz and metamorphic rock fragments. The upper part of the Pottsville also contains most of the economically important coal seams.

In Jefferson County, the Pottsville ranges from approximately 100 feet in thickness where the basal part of the formation crops out along the northwest flank of the Birmingham anticlinorium to approximately 2,800 feet in thickness in the subsurface of the Warrior Basin. In the Cahaba Ridges and Cahaba Valley, the Pottsville ranges from approximately 100 feet in thickness along Shades Mountain to possibly as much as 5,100 feet in thickness along the axial trace of the Cahaba syncline (Butts, 1910).

CRETACEOUS

TUSCALOOSA GROUP

COKER FORMATION

The Coker Formation consists of unconsolidated beds of sand, clay, and gravel. The sand is generally fine to coarse-grained grayish-orange to pale-reddish-brown quartz. The clays range from light gray to pale purple to moderate pink. Very pale-orange to grayish-orange quartz and chert gravel generally occur near the base of the formation. Secondary deposits of iron oxide (geothite-limonite) may occur locally in economic concentrations where the Tuscaloosa Group overlies deeply weathered limestone. The Coker occurs as isolated outliers in the southern part of the county where it reaches a maximum thickness of 60 feet.

QUATERNARY

QUATERNARY (?) GRAVELS

At several places in the Cahaba Valley and at one place near Chalkville, there occur unconsolidated to semiconsolidated deposits of sand, gravel, and clay of undetermined age. The deposits consist of quartzite pebbles and cobbles and some chert cobbles (ranging up to 10 inches in diameter) in a matrix of angular to subrounded chert fragments and (or) fine- to very coarse-grained quartz and chert sand. One of the best exposures is along interstate Highway 20 at Pine Ridge near Leeds where about 50 feet of these deposits is exposed.

HIGH TERRACE

Unconsolidated deposits of sand and gravel of Quaternary age occur at varying elevations above streams in the southern part of the Trafford quadrangle and in the northwestern part of the Pinson quadrangle. The gravels are composed of well-rounded quartz, quartite, and chert pebbles and cobbles. The pebbles average less than 3 inches in diameter, but cobbles may reach a diameter of 6 inches. Thickness is generally less than 10 feet (Butts, 1910).

LOW TERRACE AND ALLUVIUM

Along and immediately adjacent to the larger streams in the county are relatively recent unconsolidated deposits of gravel, sand, and silt. The constituents of these deposits have been eroded from the underlying bedrock and transported and deposited by the streams along which they occur. Chert and quartz fragments are the main components of the coarse material, but locally, fragments from any of the o'der rock units may occur. Thickness of these deposits rarely exceeds 30 feet.

STRUCTURAL GEOLOGY

Jefferson County is located in two structurally distinct physiographic provinces: the Appalachian Plateaus province to the northwest and the Valley and Ridge province to the southeast. The Appalachian Plateaus province in Jefferson County is characterized by gently dipping rocks of the Pottsville. Formation and northwest-oriented normal faults of relatively minor displacement. The area includes three regional structural features, which are, from west to east, the Arkadelphia syncline, Sequatchie anticline, and Coalburg syncline. These regional features are broad, relatively shallow structures in Jefferson County, Wrench faults occur locally along the Warrior Basin-Birmingham anticlinorium boundary, and a small number of northeast-trending normal faults occur throughout the basin. Thrust faults are rare and occur along the southeast boundary of the Warrior Basin, High-angle reverse faults are also rare in the basin. Faults that could not be classified in this report due to insufficient data were assumed to be normal, but future data may prove otherwise. Detailed information on the known faults and folds in Jeffer son County are presented in appendices A and B.

The Alabama Valley and Ridge section of the Valley and Ridge province is represented by the Birmingham Valley, Cahaba Valley, Cahaba Ridges, and Coosa Ridges physiographic districts and is characterized by northeast-trending anticlinal and synclinal structures. The major anticlinal structures are generally cut longitudinally by thrust faults. Numerous normal faults are present; reverse and wrench faults are also present locally. The major structural features include the Birmingham anticlinorium, Cahaba synclinorium, and northwestern edge of the Coosa synclinorium. The major faults include the Opossum Valley, Jones Valley, and Helena thrust faults. Most of the normal faults illustrated on the accompanying maps of the southeastern limb of the Birmingham anticlinorium are from underground iron-ore mine data and unmined areas of this part of the anticlinorium may also contain similar faults

APPALACHIAN PLATEAUS PROVINCE

WARRIOR BASIN

Numerous faults have been mapped in the Warrior Basin in Jefferson County, both on the surface and in coal mines (fig. 2). The majority of the faults mapped are normal and generally strike northwesterly. Displacements of the normal faults range from a few feet to as much as 250 feet. Along strike, displacement is generally greater near the middle part of the fault with decreasing displacement toward the extremities. Also, displacements are generally proportional to the apparent lengths of the faults. Many of the northwesterly striking faults occur in belts, or zones, that extend in a northerly direction for several miles.

Several of the northwesterly oriented faults in the Warrior Basin exhibit a slightly sinuous or arcuate strike. Thrust faulting in the Warrior Basin is confined to areas immediately adjacent to the northwestern limb of the Birmingham anticlinorium and is apparently associated with the Opossum Valley fault zone. Several wrench faults have been mapped extending across the northwest limb of the Birmingham anticlinorium into the Warrior Basin. A major thrust-wrench fault west of Bessemer offsets Rock Mountain from West Rock Mountain.

Beds of sedimentary rock in the Warrior Basin generally dip gently to the southwest except where locally disturbed by faulting or folding. Folds in the Warrior Basin range from small "rolls" present in mines and outcrops to broad shallow regional features such as the Sequatchie anticline or Coalburg

syncline. Steeply dipping beds occur along the axis of the Blue Creek anticline, and beds are steeply dipping to overturned along the southeastern border of the basin adjacent to the Opossum Valley fault zone. The steeply dipping or overturned beds along the southeastern edge of the basin general-

ly become nearly horizontal within relatively short dis-

tances. Beds located a mile or more from the southeastern edge of the basin usually dip 10° or less.

Coalburg Syncline.—The Coalburg syncline, broad and relatively flat-lying, is located between the Sequatchie anticline on the northwest and the Birmingham anticlinorium on the southeast. The northwestern flank of the syncline merges with the southeastern flank of the Sequatchie anticline. Rocks along the southeastern limb of the syncline adjacent to the Birmingham anticlinorium are steeply dipping to overturned. Numerous northwest-oriented normal faults occur throughout the Coalburg syncline in northwest Jefferson County. The Coalburg syncline apparently dies out southwest of Bessemer near the Jefferson-Tuscaloosa County boundary.

Sequetchie Anticline.--The southwestern end of the Sequetchie anticline extends into western Jefferson County. The Sequetchie anticline trends northeasterly and is asymmetrical to the northwest throughout most of its length; however, in Jefferson County the anticline is symmetrical. In northeast Alabama, the northwestern limb of the Sequetchie anticline is cut longitudinally by a thrust fault; however, in Jefferson County the anticline does not appear to be faulted and is mapped as a simple anticlinal structure. In southwestern Jefferson County, the Sequetchie anticline apparently dies out in the Pottsville Formation as shown by outcrop patterns of various coal beds (McCalley, 1898). Beds on the flanks of the anticline generally dip less than 10°.

Arkadelphia Syncline.—The Arkadelphia (Warrior) syncline parallels the Sequatchie anticline on the northwest and extends through southwestern Jefferson County. The Arkadelphia syncline is mapped in the sandstones and shales of the Pottsville Formation and apparently extends into northeast Tuscaloosa County as evidenced by the structure of the base of the Mary Lee coal seam in the Pottsville Formation (Diamond, Murrie, and McCulloch, 1976). The Arkadelphia syncline reportedly dips steeply on the east flank and gently on the west flank (Culbertson, 1984).

Blue Creek Anticline..-The Blue Creek anticline is located in Jefferson and Tuscaloosa Counties in the southeastern part of the Warrior Basin. The anticline is asymmetrical to the northwest, strikes northeast-southwest, and is similar to the Appalachian anticlinal structures. Both the northern and southern extensions of the Blue Creek anticline merge into the Birmingham anticlinorium and are cut longitudinally by thrust faults. The northernmost thrust fault is the southwestern extension of the Opossum Valley thrust fault.

Blue Creek Syncline.—The Blue Creek syncline is located in southwest Jefferson and northeast Tuscaloose Counties between the Blue Creek anticline on the northwest and the Birmingham anticlinorium on the southeast. The syncline is asymmetrical to the northwest. Beds along the southeast flank are steeply dipping to overturned, but they are gently dipping along the northwest flank. The Blue Creek syncline contains predominantly northeast-trending synclinal and anticlinal folds and northwest-trending faults. Displacement of coal seams by faulting is readily apparent on aerial photographs of strip-mined areas.

VALLEY AND RIDGE PROVINCE

In Jefferson County, the Valley and Ridge province includes the Birmingham anticlinorium, Cahaba synclinorium, and the northwestern part of the Coosa synclinorium. The

province consists of northeasterly trending valleys and ridges produced by differential weathering of rocks along the northeasterly trending anticlinal and synclinal structures. Several major thrust faults and numerous normal faults that generally parallel or subparallel major anticlinal structures also occur in Jefferson County in the Valley and Ridge province, Reverse and wrench faults are rare. The distribution and occurrence of many normal and reverse faults are known from mine data. Similar faulting may also occur throughout southeastern Jefferson County where mine, data are lacking. Several areas of complexly folded and faulted rocks occur in Jefferson County and include McAshan Mountain, West Rock Mountain, and areas adjacent to the major thrust faults.

Several structures mentioned in the literature and (or) noted in the field in Jefferson County are not included in this study due to insufficient data on their limited areal extent. These structures include faults and folds on Red Mountain at the Birmingham Expressway (U.S. 280) and 1-20 road cuts and on the northwest limb of the anticlinorium in road cuts on 1-65 and the Bessemer-Hueytown road.

Several outliers of Silurian, Cretaceous, and Quaternary rocks unconformably overlie the Knox Group and may represent collapse structures. Disturbed bedding exhibited by some of the outliers indicates the overlying younger rocks may have collapsed into solution cavities developed in the Knox carbonates.

BIRMINGHAM ANTICLINORIUM

Birmingham Anticline.-The Birmingham anticline is an eroded asymmetrical anticline that trends northeast-southwest and is located along the central and eastern parts of the Birmingham anticlinorium. The Birmingham anticline extends to the southwest into Tuscaloosa and Bibb Counties where it is obscured by overlying Cretaceous sediments. The anticline extends to the northeast into western St. Clair. County. Rocks along the southeastern limb generally dip to the southeast at 45° or less. Rocks along the axial trace and northwestern limb are generally disturbed and range from gently dipping to vertical or overturned. The axial trace of the anticline is located in rocks of the Conssauga Formation throughout most of its length in Jefferson County; however, in the northeastern part of the county, the axial trace is mapped in the overlying Ketona Dolomite and Knox Group. The east flank of the Birmingham anticline forms the east flank of the Birmingham anticlinorium and includes rocks of Cambrian to Pennsylvanian age. The west flank of the anticline is generally in rocks of Cambrian to Cambrian-Ordovician age.

Blount Mountain Syncline.-The Blount Mountain syncline strikes northeast-southwest and is located between the Birmingham anticline and the northwest flank of the Birmingham anticlinorium. In Jefferson County, the Blount Mountain syncline extends from the southwestern end of Blount Mountain in the northeastern part of the county to near Bessemer in the southern part of the county. Blount Mountain syncline varies from asymmetrical to overturned in the Bessemer area to symmetrical near Birmingham and northwestward (Butts, 1910 and 1927). The axial trace of the syncline is in the Knox Group or older rocks in Jefferson County, except in the northeastern part of the county where rocks of Cambrian to Pennsylvanian age crop out along the axial trace southwest of Blount Mountain. This part of the syncline in northeast Jefferson County is marked by thrust, normal, and wrench faults.

Opossum Valley Fault and Wylem Fault.—The Opossum Valley thrust fault is located along the northwestern limb of the Birmingham anticlinorium. It has a displacement of 7,000 feet or more where rocks of the Conssauga Formation, Ke-

P

tona Dolomite, or Knox Group are faulted into juxtaposition with younger Paleozoic rocks. Numerous faults and fault splays are associated with the Opossum Valley fault, and formations immediately west of the Opossum Valley fault are typically overturned, deformed, faulted, and locally unexposed. South of Dolomite, the Opossum Valley fault bifurcates and the two segments strike southwest and south. The southwest segment dies out along the northeastern extension of the Blue Creek anticline. The southern segment, the Wylam fault, crops out along the eastern sides of West Red Mountain, West Rock Mountain, and Rock Mountain at least as far as the Hercules Powder Company west of Bessemer.

Jones Valley Fault.—The Jones Valley thrust fault is located in the central part of the Birmingham anticlinorium along the west side of Jones Valley and immediately west of and parallel to the axial trace of the Birmingham anticline. The Jones Valley fault has an apparent maximum displacement of less than 4,500 feet where the Conasauga Formation to the southeast has been faulted into juxtaposition with the Ketona Dolomite and Knox Group to the northeast.

West Rock Mountain Structure and West End Anticline.—The West Rock Mountain structure is a wedge-shaped area between the two major southern splays of the Opossum Valley fault and includes the West End anticline and the northeastern extension of the Blue Creek syncline. The West End anticline is located along the northeastern edge of the West Rock Mountain structure and trends north to northeast. Beds along the west limb of the anticline are steeply dipping to overturned, whereas beds along the eastern limb are poorly defined due to lack of exposure. The northern and southern extensions of the anticline are terminated against the Opossum Valley fault and fault splays.

The southeastern part of the West Rock Mountain structure consists of a highly faulted and folded area where Cambrian-Ordovician, Ordovician, Silurian, and Mississippian Rocks are somewhat randomly juxtaposed. A major thrustweench fault in the area has offset Rock Mountain from West Rock Mountain by approximately 1,800 feet (Hooks, 1969).

Argo Fault.—The Argo thrust fault in northeast Jefferson County extends from near Trussville northeastward into St. Clair County near Argo. The Argo fault strikes approximately N. 50° E. in Jefferson County and dips to the northwest (Butts, 1910). Rocks as young as Mississippian are locally thrust into juxtaposition with the Knox Group of Cambrian-Ordovician age. The southern extension of the Argo fault has been mapped as far south as one mile northeast of Roebuck Plaza and includes several splays (Brockman, 1978).

Argo Anticline.-- A northeast-trending anticlinal fold located between the Cahaba Mountain syncline and the southeastern limb of the Birmipgham anticlinorium is herein referred to as the Argo anticline after the community of Argo, St. Clair County, which lies along the southeastern limb of the anticline. The Area anticline is asymmetrical to the southeast and extends from near Springville in northwest St. Clair County southwestward to near Trussville in northern Jefferson County where it plunges beneath Mississippian rocks. The Argo thrust fault parallels the Argo anticline on the southeast. Rocks along the southeastern limb of the Argo anticline and adjacent to Argo fault are steeply dipping to vertical in Jefferson County, whereas rocks along the northwestern limb of the Argo anticline dip gently to the northwest. In St. Clair County near the Jefferson-St. Clair boundary, beds on the southeast limb of the anticline are overturned and dip steeply to the northwest.

Red Gap Fault.—Red Gap fault, located along Red Gap on the southeast limb of the Birmingham anticlinorium, is a right-lateral wrench fault with over 100 feet of vertical displacement (Self, Neathery, and Jacks, 1975) and several hundred feet of lateral movement. The fault strikes N. 78° W.

and its western extension is marked by a displaced "slice" of the Red Mountain Formation that has been juxtaposed with the Knox Group.

Cahaba Mountain Syncline.—The Cahaba Mountain syncline extends from Cahaba Mountain in northwest St. Clair County to near Trussville in northeast Jefferson County. Beds along the flanks of the syncline dip gently toward the axis except along the extreme northwestern flank where faulting has produced steeply dipping beds. The relatively low dips and differential erosion along the axial trace have combined to creat numerous outliers of Hartselle Sandstone and Fort Payne Chert on the hills and ridges of the synclinal valley.

Straight Mountain Fault.—Straight Mountain fault marks the boundary between the Blount Mountain syncline and Murphrees Valley anticline in Blount, Etowah, and northeast Jefferson Counties. The Straight Mountain fault strikes northeast, dips 70° to 85° NW., and exhibits a displacement of several thousand feet (Self, Neathery, and Jacks, 1975). The southwestern extension of the Straight Mountain fault becomes obscured in the Knox Group in northeast Jefferson County near Palmerdale.

Murphrees Valley Anticline.—The Murphrees Valley anticline is a long, narrow asymmetrical fold that extends from near Ketona in northeast Jefferson County northeastward through Blount and Etowah Counties. In Blount and Etowah Counties, the anticline is characterized by gently dipping rocks on the northwest limb and vertical to overturned rocks along the southeast limb (Faust and Neathery, 1969). However, in northeast Jefferson County, the anticlinal limbs generally exhibit gently dipping beds on the southeast and steep to overturned beds on the northwest.

Ishkoode-Potter Fault System.—The Ishkoode-Potter fault system consists of a series of parallel and en echelon normal faults striking northeastward along the southeastern flank of the Birmingham anticlinorium. The system contains high-angle normal faults that form a well-developed graben along the northern extension (Simpson, 1963).

The Potter fault, located along the southern part of the system, and the Ishkooda fault, located to the north, are the two major faults within the fault system. The dips of fault planes vary greatly throughout the system and throws range from a few feet to as much as 400 feet (Simpson, 1963).

Little Valley Mountain Syncline.—Little Valley Mountain syncline is located along the southeastern limb of the Birmingham anticlinorium and the northwest limb of the Cahaba synclinorium. The syncline extends from near Cahaba Haights in northeastern Jefferson County southwestward to east Bestemer. The axial trace of this broad, shallow trough parallels Little Valley Mountain and the northern half of the Patton fault along the central part of the syncline. Throughout most of its length, the Little Valley Mountain syncline is mapped in the sandstones and shales of the Pottsville and Parkwood Formations.

Shannon Fault.—The Shannon fault is located along the southeastern limb of the Birmingham anticlinorium and displaces the sandatones and shales of the Parkwood Formation and Floyd Shale. The northern part of the fault parallels Shades Mountain on the northwest for several miles. The Shannon fault strikes approximately N. 50° E., and consists of one large normal fault and several associated faults. The fault plane exposed in the Red Mountain Formation in the Pyne and Shannon Mines dips about 60° SE., and vertical displacement ranges from 100 feet in the Pyne Mine to about 400 feet in the Shannon Mine (Simpson, 1983).

Dickey Springs-Petton Fault System.--The Dickey Springs-Patton fault system consists of a large normal fault, two reverse faults, and several associated normal faults. The Dickey Springs fault is a high-angle normal fault located near

Greenwood in the southeastern part of Shades Valley (Simpson, 1963). The Dickey Springs fault strikes approximately N. 55° E., dips to the southeast, and juxtaposes the Fort Payne Chert and Tuscumbia Limestone with the Floyd Shale. The northeastern part of the fault is marked by a fault splay that strikes approximately N. 18° E. and dips to the southeast.

The Patton fault is a high-angle reverse fault that strikes N. 50° E., dips 58° NW., and has a maximum throw of 400 feet (Simpson, 1963). The Patton fault is located along the northwest limb of the Cahaba synclinorium and parallels the northern part of Patton Creek. Near the southern extension of the Patton fault, a small reverse fault exposed on the crest of Shades Mountain displaces the Pottsville Formation 30 to 40 feet (Simpson, 1963). Several normal faults included in the Dickey Springs-Patton fault system occur where Shades Creek cuts through the Parkwood Formation near the northeastern extension of Bluff Ridge and the southwest extension of Little Shades Mountain.

Dickey Springs Anticline...The Dickey Springs anticline, located on the southeast flank of the Birmingham anticlinorium, strikes northeastward and is defined in the subsurface by drill hole and mine data. The southwestern end of the anticline plunges into the upthrown block of the Dickey Springs fault (Simpson, 1963). The northeastern part of the anticline extends into the vicinity of Shannon.

CAHABA SYNCLINORIUM

The Cahaba synclinorium is a broad asymmetrical fold marked by northeast-trending ridges and valleys and bounded by the Birmingham anticlinorium to the northwest and the Coosa synclinorium to the southeast. Rocks along the northwest limb are gently dipping, whereas rocks along the southeast limb are steeply dipping or overturned. In Jefferson County, the Cahaba synclinorium, as mapped, includes rocks of the Pottsville Formation and one small area of older rocks present between the Helena and Hog Pen Branch faults. The Cahaba synclinorium contains several independent structures, including the Helena, Hog Pen Branch, and Patton faults; Henry Ellen and Little Cahaba synclines; Dolly Ridge anticline; and the northeastern part of the Little Valley Mountain syncline. In addition to these named structural features, the synclinorium includes numerous unnamed folds and faults. The Patton fault and the Little Valley Mountain syncline are discussed in the preceding section.

Helena Fault.—The Helena fault marks the boundary between the Coosa and Cahaba synclinoria and extends from the Coastal Plain onlap in Bibb County northeestward to near Gadsden in Etowah County. In eastern Jefferson County, the Helena fault generally juxtaposes the Cambrian Rome Formation on the east with the Pennsylvanian Pottsville Formation on the west. The Helena thrust fault involves at least 10,000 feet of displacement and dips 35° SE, in the vicinity of Aldrich, Shelby County, (Butts, 1910 and 1927).

Hog Pen Branch Fault.—The Hog Pen Branch fault in northeastern Jefferson County extends from near Cahaba Heights northeastward for approximately 12 miles and intersects the Helena fault near Scott City west of Leeds. The fault was named after Hog Pen Branch, a stream along the northern part of the fault. Southwest of Scott City, a north-trending fault connects Hog Pen Branch and Helena faults. All three faults bound a triangular fault block of rocks ranging from the Pottsville Formation to the Knox Group (Butts, 1910). Butts (1907 and 1910) illustrated the Hog Pen Branch fault as a thrust or high-angle reverse fault upthrown to the southeast in the area northeast of Cahaba Heights. Butts (1927) later illustrated the Hog Pen Branch fault in some areas as a high-angle fault upthrown on the northwest. The

northern part of the fault is characterized by Pennsylvanian rocks to the northwest and Mississippian or older rocks to the southeast. Therefore, along this part of the fault rocks must be upthrown on the southeast side where the oldest rocks occur. Semmes (1929) describes the Hog Pen Branch as a typical Appalachian overthrust fault with approximately 2,000 feet of displacement that decreases to the south.

Little Cahaba Syncline.—The Little Cahaba syncline is located in northeast Jefferson County between the Hog Pen Branch fault to the northwest and the Helena fault to the southeast. The Little Cahaba syncline parallels the Helena fault and extends southwestward into Shelby County. The north end of the Little Cahaba syncline is marked by several closely folded narrow anticlines and synclines (Butts, 1910). Throughout most of its length, the syncline is asymmetrical to overturned, with gently dipping rocks on the northwest flank and steeply dipping overturned rocks on the southeast flank.

Henry Ellen Syncline...The Henry Ellen syncline is a long, narrow asymmetrical fold trending northeast parallel to the Helena fault. The syncline extends from near Henry Ellen west of Leeds northeastward into St. Clair County. Beds along the northwest limb of the syncline dip gently southeast, whereas beds on the southeast limb dip steeply northwest (Butts, 1907).

Dolly Ridge Anticline,.-The Dolly Ridge anticline is located near the central part of the Cahaba synclinorium in southeast Jefferson County and extends from near Cahaba Heights southwestward to near Hoover. The Dolly Ridge anticline is an asymmetrical doubly plunging fold that strikes approximately N. 30° E. Rocks on the southeast limb dip 20° - 52° SE., while dips of those on the northwest limb do not exceed 10° (Semmes, 1929; Self, Neathery, and Jacks, 1975). Rocks along the northwest flank have been sheared by the paralleling Patton fault (Simpson, 1963). Subsurface data indicate that the southwestern extension of the Dolly Ridge anticline merges into a sharp monoclinal structure (Simpson, 1963).

COOSA SYNCLINORIUM

The Coosa synclinorium is comprised of several smaller synclines and anticlines which generally parallel Appalachian structural trends. The northwestern edge of the Coosa synclinorium is marked by the Helena thrust fault. The small part of the synclinorium that occurs in Jefferson County includes parts of the Cahaba Valley and Coosa Ridges physiographic districts. Rocks in the Cahaba Valley in Jefferson County, range from Cambrian to Mississippian in age. The Coosa Ridges district is underlain by the Parkwood and Pottsville Formations of Mississippian and Pennsylvanian ages. The major structural feature in the Coosa synclinorium in Jefferson County is the Cahaba Valley thrust fault.

Cahaba Valley Fault.—The Cahaba Valley fault is located near the center of Cahaba Valley and trends northeastward, paralleling regional structure. In the northeastern part of Cahaba Valley in eastern Jefferson County, the fault has been mapped primarily in undifferentiated Ordovician carbonate rocks. In the southwestern part of the valley in Jefferson County, the Cahaba Valley fault juxtaposes rocks of the Knox Group on the southeast with undifferentiated Ordovician rocks on the northwest. The Cahaba Valley thrust fault dips to the southeast (Butts, 1927).

JOINTS

Joints are planes of fractures along which no significant displacement has occurred. A joint set is defined as a regional pattern, or groups, of parallel joints (Gary, McAfee, and Wolf, 1972). Joints and joint sets occur throughout the rocks of Jefferson County and are often important features to be considered in underground mining. Joints have served as guides for mine development in the underground iron ore mines in Jefferson County because blasting along major joints generally produces a straight, nearly vertical face in the ore (Simpson, 1963).

A joint strike diagram by Simpson (1963) indicates the two major trends of the joint traces are N. 40° - 50° E. and N. 60° - 70° W. The angle of dip of joints in Jefferson County generally ranges from 70° to 90°; however, some dips as low as 30° NW, and 10° SW, have been noted (Simpson, 1963). The lineal extent of most of the joints ranges from a few feet to several hundred feet. The vertical extent of joints varies with the thickness of the "host" rock, Joints are generally confined to one bed in thin-bedded rocks but may extend vertically through several beds of thick-bedded rocks (Simpson, 1963). Spacing between joint traces also varies with the thickness of the host rock; greater spacing of joints occurs in thicker beds (Simpson, 1963).

Joints are often indicative of stress systems that produce faults and folds. The strike of the largest concentration of joints approximately concides with the general strike of faults in the southeastern part of Jefferson County, and the number of joint sets increase in areas contiguous to large folds and major faults (Simpson, 1963).

LINEAMENTS

Lineaments, or linears, are features in an aerial photograph or remotely sensed image that lead the eye in a definite line. Lineaments may be defined by a number of different features, or signatures, along their length, a straight stream segment, a linear tonal anomaly in vegetation patterns, an offset in topographic features such as ridges and valleys, or simply a linear arrangement of light and dark tones. These may all combine to produce an apparent line on the image. Straight man-made features such as roads, railroads, canals, pipelines, powerlines, and land boundaries must be identified and disregarded. Lineaments from remotely sensed images have been found in Alabama to reflect fault zones, faults, zones of water movement, joint systems, and mineralized zones (Drahovzal and Copeland, 1970; Powell and LaMoreaux, 1971; and Powell and others, 1970). An assessment of lineaments in Jefferson County was made in hopes that the location of airphoto lineaments and lineaments from remotely sensed images would provide information on the location of faults or fault zones in areas where extensive field work could not be done.

Three different types of imagery were used in this study to provide thorough coverage of Jefferson County at several map scales. The smallest scale image, covering the largest area, was a 1:250,000 Black-and-white band 6 print dated February 14, 1977, from the Landsat spacecraft multispectral scanner. Intermediate-scale imagery was provided by a NASA U-2 high-altitude aircraft as 1:130,000 color infrared (CIR) photography. The largest scale imagery used was black-and-white orthophotoguads at a scale of 1:24,000.

Two different types, or classes, of lineaments were noted during the study, and the lineament traces were plotted on the geologic maps of the county. Long, softly defined lineaments ranging from about 10 to 90 miles in length were visible on the Landsat scanned image and both types of photography, although the Landsat image showed them most clearly; these were designated Class I lineaments. Shorter

more sharply defined lines ranging from ½ mile to about 8 miles in length were more easily visible on the photographs and were designated Class II lineaments.

Class I lineaments were found to have some correlation with the known faults in the study area. The orientation of these lineaments ranged from approximately N. 80° E. to N. 80° W., with some clustering around N. 20° W. This clustering appears to correspond to the general northwest trend of the faults in the Warrior Basin and the trend of the faults not coincident with Appalachlan strike in other parts of the county. These lineaments, which are always defined by more than one type of signature along their length, have been found in other areas in Alabama to indicate zones of increased porosity and water movement, and may possibly be deep-seated fractures in the earth's crust. In carbonate terranes, it is common for sinkholes to be developed along lineament traces.

Class II lineaments had much higher correspondence with known faults than did Class I lineaments, and lineaments seen in CIR photography frequently corresponded with those on the orthophotoquads. (For examples, see geologic maps 7, 8, 13, 14, 20, 21.) These lineaments appeared as distinct, relatively short lines and often were defined by a single type of signature—for example, a straight dark line, a light line along a straight stream segment, or the alignment of offsets in topographic features. The strikes of these lineaments ranged from N. 60° E. to about N. 58° W., with very strong clustering between N. 10° W. and N. 45° W. This clustering also corresponded to the orientation of the strikes of most of the known faults in the Warrior Basin and of many of those faults not coincident with Appalachian trends in other parts of the county.

It should be noted that lineaments corresponding to known faults striking northeastward along the general trend of Appalachian structure were difficult to impossible to discern. In some cases a lineament signature for a known fault coincident with the strike of Appalachian structures was visible, but as a general rule it was impossible to differentiate between the ridge lines, valleys, and lineaments. Also, the locations of lineaments from the Landsat image are not geographically exact owing to the scarcity of identifiable horizontal control points on the image.

An airphoto lineament or a lineament from remotely sensed data does not positively indicate a fault; however, the technique of lineament analysis is becoming a useful tool in the location of previously unknown structures when combined with standard research and field methods.

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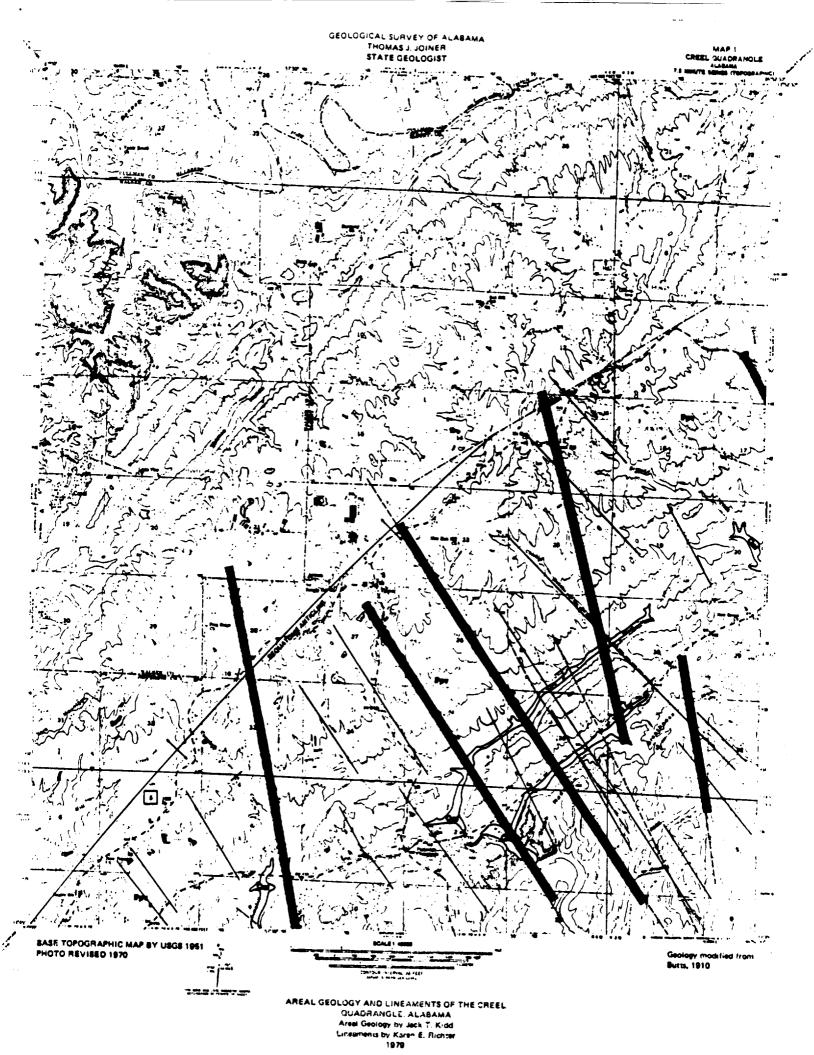
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,		MAPE	RELANATION	
		Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY		High terrace deposits		Lineaments from U.S. Geological Survey
		Possible terrace of questionable age		7%-minute orthophotoqueds, 1976.
CRETACEOUS	\ <u>\</u>	Coller Formation: Tuscaloose Group		Lineaments from National Aeronautics and Space Administration High-altitude color-infrared photography,
PENNSYLVANIAN		Pottsville Formation		February 22, 1973.
	} <u></u>	Parkwood Formation	\rightarrow	Anticline, exial trace
		Floyd Shale		Anticline, exial trace showing direction of plunge
		Bengor Limestone	<u>+</u>	Syncline, axiel trees
MISSISSIPPIAN		Hertselie Sandstone	†	Synctine, exist trace
	Man	Pride Mountain Formation	-	showing direction of plungs
	1800	Tuscumbia Limestone, Fort Payne Chert, and Meury Formation		Fault, relative movement not known
DEVONIAN	(Chattanoogs Shale and Frog Mountain Sandstone	<u> </u>	Normal fault: U, upthrown side: D, downthrown side
SILURIAN	{ ==	Red Mountain Formation	==	Thrust fault, T on upper plate
		Chickemouge Limestone	-	Fault, showing relative horizontal movement
ORDOVICIAN	0=	Attalia Chert Conglomerate	<u> </u>	Reverse fault, R on upthrown side
GREGOVICIAN		Member: Chickemauge Limestone		Strike and dip of bads
		Ordovician undifferentiated	4	Strike and dip of overturned bads
		Knox Group undifferentiated Ketone Colomite	+	Strike of verticel bads
CAMBRIAN		Consisues Formation	•	Herizontal beds
		Rome Fermetian		Contact of geologic units, detted where consecled
	رلتا	Formation symbol enclosed in perentheses	\odot	Fault reference number
		where formation is concealed.	O	Fold reference number
	•			Faults, synetimes and anticlines are deshed where interest destend where proposed

The illustrated symbols do not necessarily appear on all maps.

Faults, synalines and anticlines are deshed where inferred; dotted where consessed.

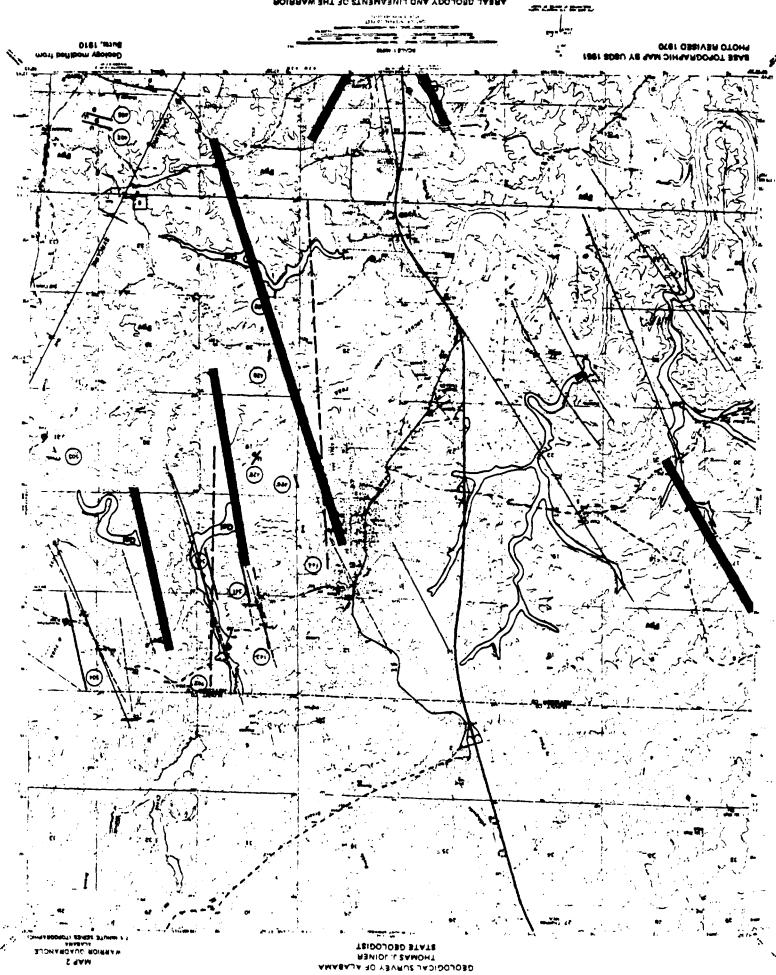


		Alluvium and low terrace deposits		Lineaments from LANDSAT bend-6 print, February 1977.
QUATERNARY	{ •	High terrace deposits		
	(a)	Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotogueds, 1975.
CRETACEOUS	(Calter Formation: Tuscaloosa Group	200	Lineaments from National Aeronautics and Space Administration High-altitude color-infrared photography,
PENNSYLVANIAN	₹	Pottsville Formation		February 22, 1973.
	Free	Peritwood Formetion	+	Anticline, axiel tress
		Floyd Shale		Anticine, axial trace
		Bengor Limestone	▼	showing direction of plungs
MISSISSIPPIAN		Hartselle Sandstone	- ;-	Synctine, axiel trace
				Synctine, axial trace
	****	Pride Mountain Formation		showing direction of plunge
		Tuesumbie Limestone, Fort Payne Chert, and Maury Formation		Fault, relative movement not known
DEVONIAN	√ Outm	Chattanoogs Shale and		Normal fault: U, upthrawn side: D, downthrown side
		Frag Mountain Sendstone	•	U, godinim dani mas
SILURIAN	(Red Mountain Formation	44	Thrust fault, T on upper plate
		Chickeneuge Limestone	- -	Fault, showing reletive horizontal movement
ORDOVICIAN	000	Attalla Chert Conglomerate	4.4	Reverse fault, R on upthrown side
ONDOVICIAIN		Member: Chickemauga Limestone	_	Strike and dip of beds
		Ordovician undifferentiated	4	Strike and dip of overturned bads
		Knox Group undifferentiated	—	Strike of vertical bods
		Ketene Dolomite	•	Horizontal bada
CAMBRIAN	10	Consssuge Formation		Contest of sectoris units, docted where consected
		Rome Formation	$\widetilde{\Omega}$	Fault reference number
•	•	Formation symbol englaced in parentheses		
		where fermation is consoled.		Fold reference number
	•			Faults, synalines and anticlines are deshed

The illustrated symbols do not necessarily appear on all maps.

Faults, synalines and anticlines are deshe where inferred; dotted where conceeled. AREAL GEOLOGY AND LINEAMENTS OF THE WARRIOR

OUADRANGLE, ALABANA
Anaul Geology by Jack T, Kidd
Lineament by Karan E, Righter
1978



A		Alluvium and low terrace deposits		Lineaments from LANOSAT band & print, February 1977.
QUATERNARY		High terrace deposits Possible terrace of questionable age	/	Lineaments from U.S. Geological Survey 7%-minute orthophotoqueds, 1975.
CRETACEOUS	(Calter Formation: Tuscaloose Group	2000	Lineaments from Netional Aeronautics and Space Administration High-eltitude color-infrared photography,
PENNSYLVANIAN	₹	Pottsville Formation	•	February 22, 1973.
		Parkwood Formation	+	Antidline, axiel trees
		Floyd Shele		Amicline, exiet trace showing direction of plunes
-		Sengor Limestone	Ĭ	• • • • • • • • • • • • • • • • • • • •
MISSISSIPPIAN	₹	Hertseile Sandstone	+	Syncline, axial trace
				Synctine, axial trace
		Pride Mountain Formation	1	showing direction of plunge
	-	Tussimble Limestone, Fort Peyne Chert, and Meury Formation		Fault, reletive movement not known
DEVONIAN	/	Chettenoogs Shale and	U	Normal fault: U, upthrawn side:
5610/1441	(Description)	Frog Mountain Sandstone	D	D, downthrown side
SILURIAN	{ •••	Red Mountain Formation	44	Thrust fault, T on upper plats
		Chickemouge Limestone		Fault, showing relative horizontal movement
ORDOVICIAN		Attalle Chert Conglomerate	<u> </u>	Reverse fault, R on upthrown side
		Member: Chickerneuge Limestone		Strike and dip of bods
		Ordavicien undifferentisted	4	Strike and dip of overturned bade
	(000	Knex Group undifferentiated		Strike of vertical bads
	•	Ketone Delomite		Horizontal bada
CAMBRIAN	1	Consumps Formation	·	Centest of geologic units, dotted where concealed
		Rame Farmation	\odot	Foult reference number
•		Formation symbol anclosed in parentheses where formation is conceeled.		Fold reference number
	•		_	Faults, pynolines and enticlines are deshed

The illustrated symbols do not necessarily appear on all maps.

Faults, synclines and enticlines are deshed where inferred; dotted where conceeled. BASE TOPOGRAPHIC I

GEOLOGICAL SU

		<u> </u>	Alluvium and low terrace deposits		Lineaments from LANOSAT bend-6 print, February 1977.
QUATERNARY	₹ •	•]	High terrace deposits		
		7	Possible terrece of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoqueds, 1975.
CRETACEOUS	{ 🚾		Coller Formation: Tuscaloose Group	100	Lineaments from National Aeronautics and Space Administration High-etitude color-infrared photography.
PENNSYLVANIAN	{ ┏		Pottsville Formation		February 22, 1973.
	} ■		Parkwood Formation	+	Antieline, skiel trace
		•	Floyd Shele		Anticline, exiet trees showing direction of plunes
	[**	.	Bangor Limestone	i	
MISSISSIPPIAN	₹ Ē	<u></u>	Hertselle Sandetone	+	Syndine, exial trace
		\equiv			Synetine, axiel trace
			Pride Mountain Formation	•	showing direction of plungs
		•	Tuecumble Limestone, Fort Payne Chert, and Maury Formation		Fault, relative movement not known
			Chattanooss Shale and	U	Normal fault: U, upthrown side:
DEVONIAN	1 [≥		Frog Mountain Sendstone		D, downthrown side
	\tilde{c}				
SILURIAN	<u>•ا</u> }		Red Mountain Formation		Thrust fault, T on upper plate
		⊡	Chickemouse Limestone	-#	Fault, showing relative horizontal movement
ORDOVICIAN		- 1	Attalla Chert Conglomerate		Reverse fault, R on upthrown side
ORDOVICIAN			Member: Chickensuge Limestone	-4-	Strike and dip of bads
	يا ا	<u>-</u>	Ordovicien undifferentiated	4	Strike and dip of overturned bads
	ها ۲		Knez Group undifferentieted	-+-	Strike of vertical bade
		•]	Ketone Ociomite	•	Herizontal bads
CAMERIAN	1 🖸	•	Consseuge Formation		Comment of analysis upto describe the second
		_	Name Formation		Comtact of geologic units, dotted where concealed
	ζ		The second second	\odot 0	Foult reference number
			Formation symbol anclosed in perentheses where formation is concepted.	- Õ	Fold reference number
				بي .	_

The illustrated symbols do not necessarily appear on all mags.

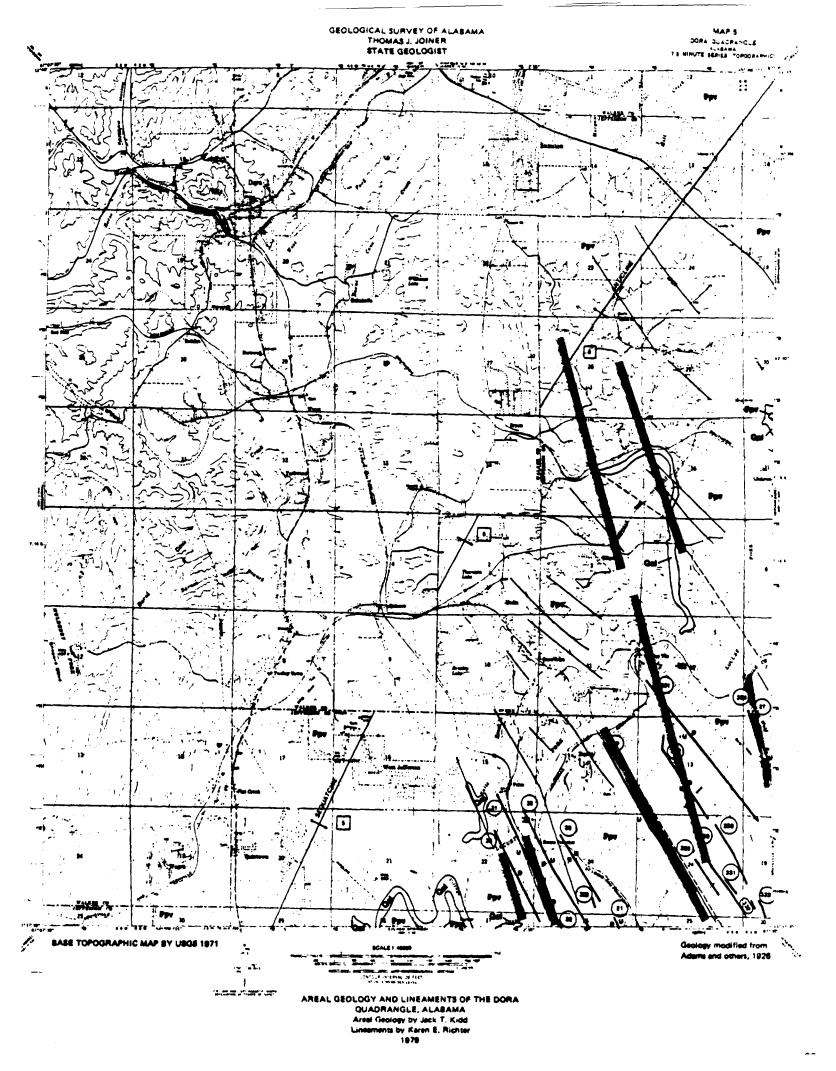
Faults, syndlines and anticlines are deshed where inferred; dested where concealed.

QUADRANGLE, ALABAMA Areal Geology by Jack T. Kidd Lineaments by Keren E, Richter 1979

		Alluvium and low terrace deposits		Lineaments from LANDSAT bend-6 print, February 1977.
QUATERNARY		High terrace deposits		Uncoments from U.S. Geological Survey
	العال	Possible terrace of questionable age		7%-minute orthophotoqueds, 1976.
CRETACEOUS	{ 🙃	Coker Formetion: Tuscaloosa Group		Lineaments from National Aeronautics and Space
PENNSYLVANIAN	{ ☲	Pottsville Formation		Administration High-altitude color-infrared photography, February 22, 1973.
	7	Parkwood Formation		Anticline, exial trace
		Floyd Shale		Anticline, axial trace showing direction of alunes
	I NO	Bangor Limestone	, ,	endening direction or brands
MISSISSIPPIAN	{ <u> </u>	Hertselle Sandstone		Syncline, exial tress
	1	Pride Mountain Formation	+	Synctine, axial trace showing direction of plungs
		Fried Modifian Formation	*	snowing exection or previous
	1000	Tuscumbia Limestone, Fort Payne Chert, and Meury Formation		Fault, relative mavement not known
B41404144	·	Chattanoogs Shale and	u	Normal fault: U, upthrown side:
DEVONIAN	(Frog Mountain Sandstone		O, downthrown side
SILURIAN	=	Red Mountain Formation		Thrust fault, T on upper plate
		Chickamouge Limestone		Fault, showing relative harisontal movement
ORDOVICIAN		Attalle Chert Conglomerate	<u>هـ</u> هـ	Reverse fault, R on upthrown side
ONDOVICIAN		Member: Chickemauge Limestone		Strike and dip of bods
		Ordovician undifferentiated	4	Strike and dip of overturned bade
		Knex Group undifferentiated		Strike of vertical bads
		Ketene Determite	•	Horizontal bade
CAMBRIAN	1	Consssugs Formation		Contest of geologic units, docted where concessed
		Reme Formation		Fault reference number
		Formation symbol enclosed in parentheses where formation is conceed.		Fold reference number
		The second secon		Faults, synalines and enticlines are deshed

^{*}The illustrated symbols do not necessarily appear on all maps.

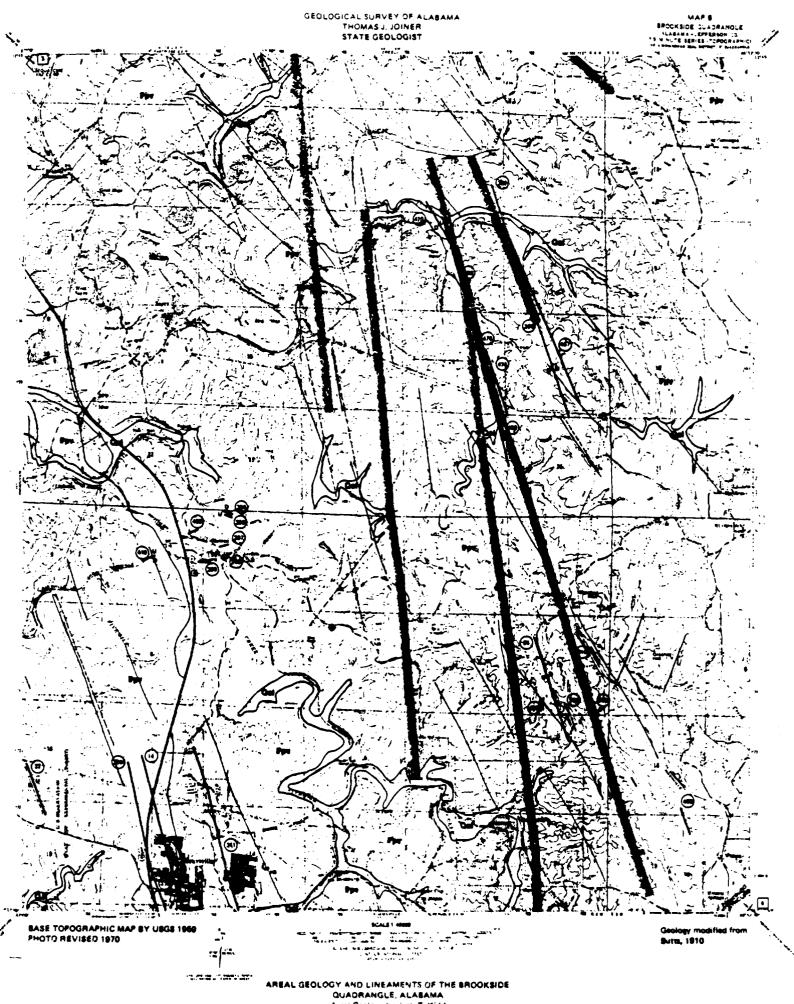
where interest; dotted where concepted.



444			Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY		Q 2	High terrace deposits Possible terrace of questionable age	/	Lineaments from U.S. Geological Survey 7%-minute orthophotoqueds, 1975.
CRETACEOUS	{		Coker Formation: Tuscaloose Group		Lineaments from National Aeronautics and Space Administration High-altitude color-infrared photography,
PENNSYLVANIAN	۲۱	<u>~</u>	Pottsville Formation	•	February 22, 1973.
	ام		Perkwood Formation	-	Anticline, axial trace
	14		Floyd Shate		Anticline, exist trace showing direction of plunes
		-	Sanger Limestone		Syncline, axial trace
MISSISSIPPIAN	{		Hertselle Sendstone	†	
		14-11	Pride Mountain Formation		Synctine, exist trace showing direction of plungs
		Mag	Tusoumbia Limestone, Fort Payne Chert, and Meury Formation		Fault, reletive movement not known
DEVONIAN	{	Dates	Chettanooge Shele and Frog Mountain Sandstone	<u> </u>	Normal fault: U, upthrown side: D, downthrown side
SILURIAN	{		Red Mountain Formation	44	Thrust fault, T on upper plate
			Chickemeuge Limestone		Fault, showing relative horizontal movement
ORDOVICIAN	H	0.0	Attalle Chert Conglomerate	<u> </u>	Reverse fault, R on upthrown side
ONDOVICIAN	1		Member: Chickenauge Limestone		Strike and dip of beds
		<u>*</u>	Ordovicien undifferentieted	4	Strike and dip of overturned bads
		000	Knox Group undifferentiated	-	Strike of vertical bads
			Ketone Dolamise	•	Horizontal bads
CAMBRIAN	11	•	Consesuge Formation		Contest of espicels units, dotted where concealed
	U		Rame Formation	\odot	Foult reference number
•	•		Formation symbol analosed in parentheses where formation is concepted.		Feld reference number
				<u>.</u>	Routes annother and exclution are derived

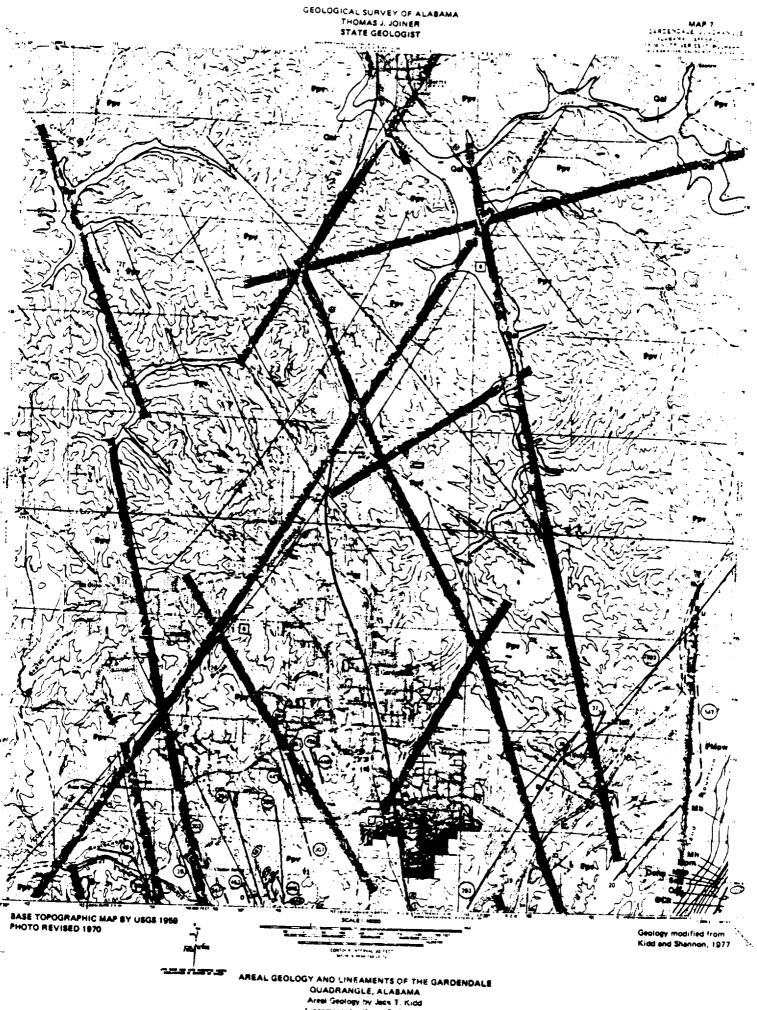
The illustrated symbols do not necessarily appear on all maps.

Fourte, synolines and antiglines are deshed where inferred; detted where concessed.



AREAL GEOLOGY AND LINEAMENTS OF THE BROOKSIDE QUADRANGLE, ALABAMA Area Geology by Juck T. Kidd Lineaments by Karen E. Richter 1979

		Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY	ا كا	High terrace deposits		
	<u>av</u>	Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute enthophotoqueds, 1978.
CRETACEOUS	₹	Coller Formation: Tuscaloosa Group	2000	Lineaments from National Aeronautics and Space Administration High-attitude color-infrared photography,
PENNSYLVANIAN	₹	Pottsville Formation		February 22, 1973.
	}	Parkwood Formation	\rightarrow	Antidine, axiel trace
		Floyd Shale		Anticline, exiet trace
		Sengor Limestone	•	showing direction of plunge
MISSISSIPPIAN	⇃☶	Hartzelle Sendstone	1	Syncline, axial trace
			<u> </u>	Syncline, axiel trace
		Pride Mountain Formation	•	showing direction of plunge
		Tuesumble Limestone, Fort Payne Chert, and Meury Formation		Fault, relative movement not known
DEVONIAN	<i>/</i> — —	Chettanoogs Shale and		Normal fault: U, upthrown side:
DEVONIAN	ζ (Dee	Frog Mountain Sendstone	-	D, downthrown side
SILURIAN	=	Red Mountain Formation	4-4	Thrust fault, T on upper plate
		Chickemouga Limestone	-	Fault, showing relative horizontal mevement
ORDOVICIAN	040	Attalia Chert Conglomerate	<u> A A</u>	Reverse fault, R on upthrown side
		Member: Chickemauge Limestone		Strike and dip of bods
		Ordovicien undifferentiated	4	Strike and dip of overturned bade
		Knox Group undifferentiated	-+-	Strike of vertical bads
		Ketona Dolemite	•	Horizontal bads
CAMBRIAN		Consisuge Fermation		Contact of geologic units, dotted where concessed
		Rome Fermation	\odot \odot	Foult reference number
		Formation symbol englessed in perentheses where formation is concealed.	Ō	Fold reference number
		•		Faults, synolines and antiplines are dashed where inferred; dotted where concested.
		The illustrated symbols do not necessarily appr	er on all maps.	रराज्य व स्थाप्त व्यव्ह व्यवस्थित स्थाप्त व व्यवस्थित व्यवस्थ



Arest Geology by Jack T. Kidd Lineaments by Karen E. Richter 19/9

			Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY	1	O	High terrace deposits		
	ļ	Ok?	Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoqueds, 1975.
CRETACEOUS	ţ	Ke	Coker Formation: Tuscaloosa Group	,,,,	Lineaments from National Aeronautics and Space Administration High-attitude color-infrared photography,
PENNSYLVANIAN	{	Pps	Pottsville Formation		February 22, 1973.
	ŕ	P149-0	Parkwood Formation		Anticline, axiel trace
		147	Floyd Shale	+	Anticline, axiel trace showing direction of plunge
	ı		Bengor Limestone		
MISSISSIPPIAN	{	140	Hartseile Sandstone		Synctine, axial trace
	1				Synctine, axial trace
		Mpm	Pride Mountain Formation	•	showing direction of plunge
		Medy	Tuscumbis Limestone, Fort Payne Chert, and Maury Formation		Fault, relative movement not known
	ſ		Chattanoogs Shale and	u	Normal fault: U, upthrown side:
DEVONIAN	ĺ	Outro	Frog Mountain Sendstone		D, downthrown side
SILURIAN	{	8rm	Red Mountain Formation	77	Thrust fault, T on upper plate
		•	Chickemouge Limestone		Fault, showing relative horizontal movement
ORDOVICIAN	Į	Ome	Attalla Chert Conglomerate Member: Chickamaues Limestone		Reverse fault, R on upthrown side
)		member. Crickemacy Carestons	_	Strike and dip of bads
		8	Ordovician undifferentiated	4	Strike and dip of overturned bads
	ĺ	<u> </u>	Knox Group undifferentiated	+	Strike of vertical bade
	1	**	Ketone Dolomits	•	Horizontal bada
CAMBRIAN	1	•	Consseugs Formation		Contact of scalegic units, dected where conscaled
			Rome Formation	$\widetilde{\mathbb{Q}}$	Fault reference number
			Formation symbol anclosed in parentheses	<u> </u>	
			where fermation is concealed.		Fold reference number
					Faults, synalines and anticlines are deshed

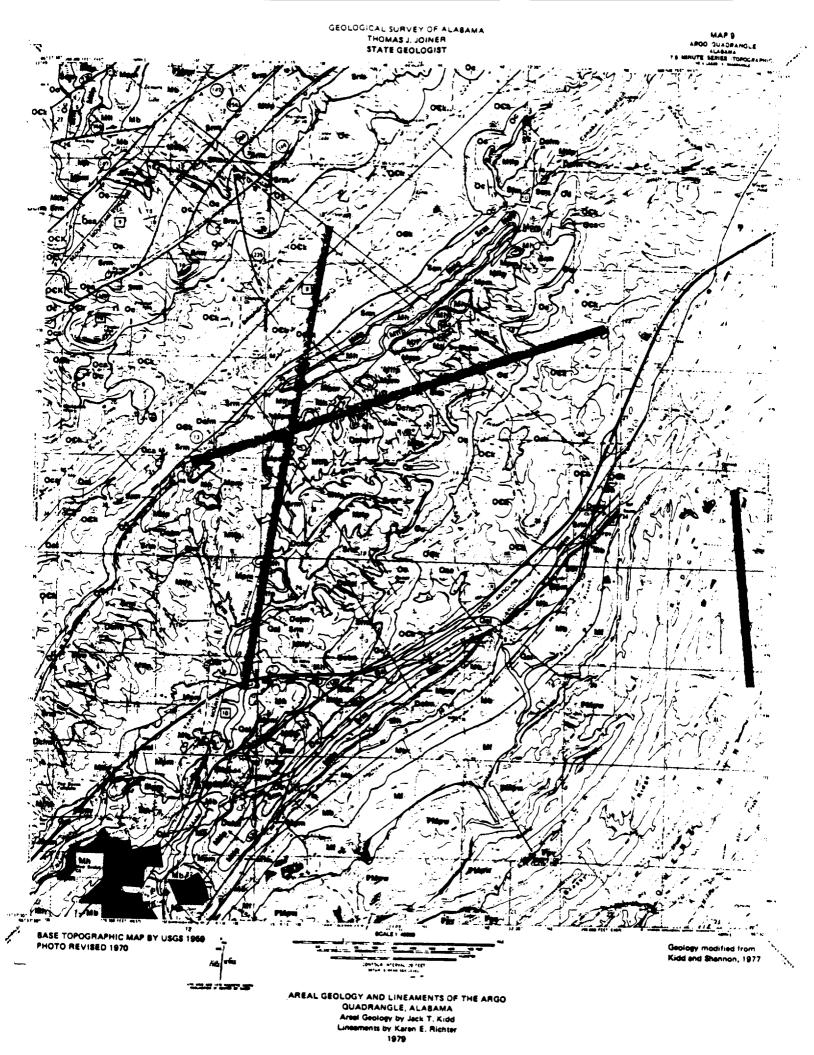
The illustrated symbols do not necessarily appear on all maps.

where inferred; dotted where concessed."

		Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY		High terrace deposits Possible terrace of questionable age		Lineaments from U.S. Geological Survey
CRETACEOUS	}	Color Formation: Tuesdoos Group		7%-minute orthophotoqueds, 1975.
PENNSYLVANIAN	} =====================================	Potraville Formation		Lineaments from National Aeronautics and Space Administration High-altitude color-infrared photography, February 22, 1973.
		Parkwood Formation		Anticline, axial trace
		Floyd Shale		Anticline, exist trace
		Sengor Limestone		showing direction of plunge
MISSISSIPPIAN	$\{ \overline{\Box} $	Hertseile Sandstone	+	Syncline, axial trace
		Pride Mountain Formation	- i	Synctine, axial trace showing direction of plunge
	100	Tuscumbia Limestone, Fort Payne Chert, and Maury Formation		Fault, reletive movement not known
DEVONIAN	{ 	Chattanooga Shale and Frog Mountain Sandstone	- u	Normal fault: U, upthrawn side: D, downthrown side
SILURIAN	{=	Red Mountain Formation		Thrust fault, T on upper plate
		Chickemouge Limestone	~	Fault, showing reletive horizontal movement
ORDOVICIAN	-	Attalla Chart Conglomerate Member: Chickamaues Limestone		Reverse fault, R on upthrown side
	[@	Ordovicien undifferentiated	- -	Strike and dip of bads
	\ <u></u>	Knox Group undifferentiated		Strike and dip of overturned bade Strike of vertical bads
	9 :	Ketone Dolomite	•	Horizontal bask
CAMBRIAN		Consseuga Formation		Contact of gaslagic units, detted where concealed
		Rome Formation	① ①	Fault reference number
•		Formetion symbol enclosed in perentheses where formation is conceeled.		Fold reference number
	•			Foults, syndlines and anticlines are deshed

The illustrated symbols do not necessarily appear on all maps.

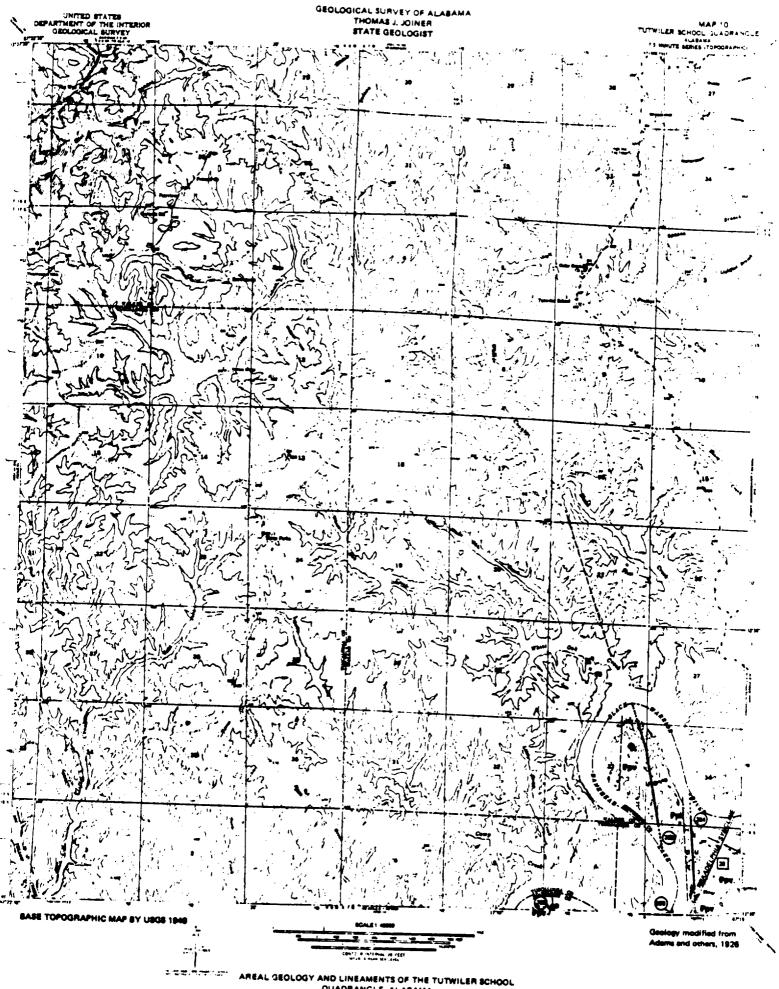
Foults, synctines and antichines are deshor where inferred; dected where conceeled.



		Alluvium and low terrace deposits		Lineaments from LANDSAT bend-6 print, February 1977.
QUATERNARY		High terrace deposits		Lineaments from U.S. Geological Survey
	} =====================================	Possible terrace of questionable age		7%-minute orthophotoqueds, 1975.
CRETACEOUS	\ <u>.</u>	Coker Formation: Tuscaloosa Group	ممر	Lineaments from National Aeronautics and Space Administration High-eltitude color-infrared photography,
PENNSYLVANIAN	{ <u></u>	Pottsville Formetion		February 22, 1973.
		Parkwood Formation	+	Anticline, axial trace
		Floyd Shale		Anticline, exial trace showing direction of plunge
	l lab	Sengor Limestone	¥	
MISSISSIPPIAN	∤ ॗ	Martselle Sendstone	+	Synetine, axial trace
				Synctine, exial trace
	Man .	Pride Mountain Formation	t	showing direction of plunge
	Meso	Tuscumbia Limestone, Fort Psyne Chert, and Maury Formation		Fault, relative movement not known
	/	Chattanooss Shale and	v	Normal fault: U, upthrown side:
DEVONIAN	{ [0+++-]	Frog Mountain Sendstone	-	D, downthrown side
SILURIAN	(Red Mountain Formation		Thrust fault, T on upper plate
		Chickemouge Limestone		Fault, showing relative herizontal movement
ORDOVICIAN	000	Attalla Chert Conglomerate	44	Reverse fault, R on upthrown side
UNDU VICIAII		Member: Chickemauge Lenestone		Strike and dip of bods
		Ordovicien undifferentiated	4	Strike and dip of overturned bads
-) (OS)	Knex Group undifferentiated		Strike of vertical bads
		Ketone Delemite	•	Moriannest bade
CAMBRIAN		Consseugs Fermation		Contest of geologic units, decised where concessed
		Rome Formation	$\widetilde{\Omega}$	Fault reference number
•	•	Formation symbol enclosed in parentheses		The second secon
		where formation is consecled.	•	Fold reference number
	•			Equips, expellent and anticking are deshed

The illustrated symbols do not necessarily appear on all maps.

Faults, synelines and anticlines are deshed where inferred; detted where concealed.

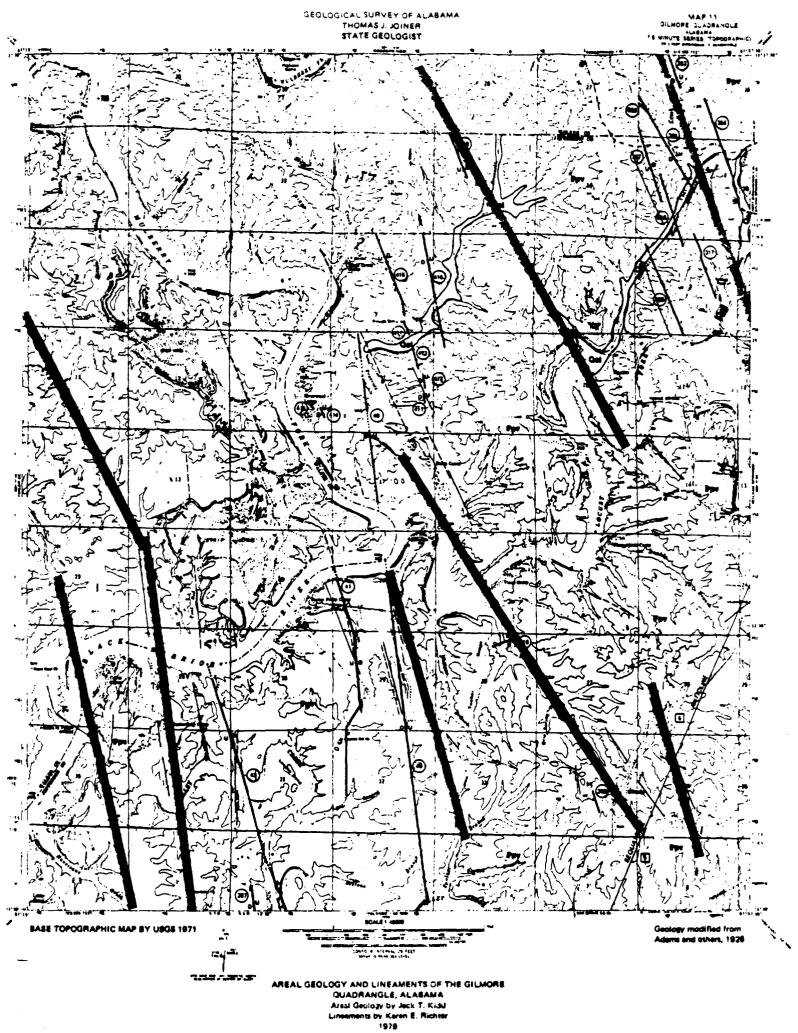


AREAL GEOLOGY AND LINEAMENTS OF THE TUTWILER SCHOOL QUADRANGLE, ALABAMA Areal Geology by Jack T. Kidd Lineaments by Keren E. Richter 1878

		Alluvium and low terrace deposits		Lineaments from LANDSAT bend-6 print, February 1977.
QUATERNARY	{ 🕒	High terrace deposits		
	<u>G2</u>	Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoquads, 1976.
CRETACEOUS	((6)	Coller Formation: Tuscaloosa Graup		Lineaments from Netional Aeronautics and Socce Administration High-altitude color-infrared photography,
PENNSYLVANIAN	{ 	Pottsville Formation		February 22, 1973.
	} ****	Parkwood Formation	-;-	Anticline, sxiel trace
	M#	Floyd Shele		Anticline, axial trace
				showing direction of plungs
		Bengar Limestone	<u> </u>	Synctine, exial trace
MISSISSIPPIAN	(Hertselle Sandstone	†	Symulting, axign trans
				Synctine, axial trace
		Pride Mountain Formation	+	showing direction of plungs
	Image:	Tuscumbis Limestone, Fort Psyne Chert, and Meury Formation		Fault, relative movement not known
	<i>(</i>	Chercanooga Shale and	U	Normal fault: U, upthrown side:
DEVONIAN	{ [Defin]	Frog Mountain Sendetone	•	D, downthrown side
SILURIAN	=	Fled Mountain Formation		Thrust fault, T on upper plate
	(•	Chickameuge Limestone		Fault, showing relative horizontal movement
ORDOVICIAN	0==	Attalle Chert Conglomerate Member: Chickemeuss Limestone	<u>* * *</u>	Reverse fault, R on upthrown side
		member: Chickemade Limestone		Strike and dip of bads
		Ordovician undifferentiated	4	Strike and dip of overturned beds
	(000	Knox Group undifferentiated		Strike of vertical bads
		Ketone Dolemite	•	Horizontal bads
CAMBRIAN	10	Consesuge Formation		Contact of goologic units, dotted where concealed
		Name Fermation	\odot	Fault retorange number
		Formation symbol enclosed in parentheses where formation is concented.) ()	Fold reference number
		may remotion is concepted.	ت	
		•		Faults, pynelines and anticlines are deshed

The illustrated symbols do not necessarily appear on all maps.

Faults, synctines and anticlines are deshed where inferred; detect where conceeled.



QUATERNARY	(a)	Alluvium and low terrace deposits High terrace deposits		Lineaments from LANDSAT band-6 print, February 1977,
		Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoquads, 1975.
CRETACEOUS	{ 🐷	Coker Formetion: Tuscalooss Group	100	Lineaments from National Aeronautics and Space Administration High-attitude celer-infrared photography,
PENNSYLVANIAN	{ 	Pottsville Formation	•	February 22, 1973.
	}	Parkwood Formation	+	Anticline, axiel trace
	-	Floyd Shale	+	Anticline, axiel trace showing direction of plungs
		Bengor Limestone	<u>.</u>	Syncline, axial trace
MISSISSIPPIAN	√ ™	Hertselle Sandstone	†	Transfer to the state of the st
			<u> </u>	Syncline, axiel trass
	Man	Pride Mountain Formation		showing direction of plungs
	-	Tuseumbie Limestone, Fort Payne Chert, and Meury Formstien		Fault, reletive movement not known
DEVONIAN	/ [Chattanoogs Shale and		Normal fault: U, upthrown side:
5610111111	{ Defin	Frog Mountain Sendstone	-0	D, downthrown side
SILURIAN	=	Red Mountain Formation		Thrust fault, T on upper plate
	0	Chickamauge Limestone		Fault, showing reletive horizontal movement
ORDOVICIAN		Attalla Chert Conglomerate Member: Chickemauss Limestone	4.4	Reverse fault, R on upthrown side
• • • • • • • • • • • • • • • • • • • •		member: Crickenbogs Emissions	-	Strike and dip of bods
		Ordovicien undifferentiated	4	Strike and dip of overturned bads
	(082	Knex Group undifferentiated		Scrike of vertical bade
		Ketone Dolomite	•	Horizontal bads
CAMBRIAN		Consessuge Formesian		Contact of geologic units, dected where concealed
	(•	Reme Formation	\odot	Foult reference number
•		Formation symbol analosed in perentheses		Rold advances auction
		where formation is sonceried.	ك ا	Fold reference number
	_			Faults, mentions and enticlines are deshed

The illustrated symbols do not necessarily appear on all maps.

Faults, syndines and enticlines are deshed where inferred; dotted where concealed.

GEOLOGICAL SURVEY OF ALABAMA
THOMAS J. JOINER MAP 12 SYLIAN SPRINGS DUADRANGE ALABAMALEFFERSON D 15 WINUTE SERIES TOPOGRAPHIC) STATE GEOLOGIST BASE TOPOGRAPHIC MAP BY USGS 1971 Geology modified from Adams and others, 1926 -7 -z. AREAL GEOLOGY AND LINEAMENTS OF THE SYLVAN SPRINGS GUADRANGLE, ALABAMA Arest Geology by Jeck T. Kidd Lineamerits by Karen E. Richter 1979

i'				
		Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, Fabruary 1977.
QUATERNARY	{ ┗	High terrace deposits		Allowers from 11.0 Contraint Super-
	(a)	Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoquads, 1975.
CRETACEOUS	₹ ■	Coker Formation: Tuscaloose Group		Lineaments from National Aeronautics and Space Administration High-altitude color-infrared photography,
PENNSYLVANIAN	=	Patssville Formation	1	February 22, 1973.
	7	Parkwood Formation		Anticline, axial trace
		Floyd Shale	-	Anticline, axial trace showing direction of plungs
•		Sengor Limestone		Synctine, axial trace
MISSISSIPPIAN	(Hertselle Sandstone	•	• • • • • •
		Pride Mountain Formation	-	Synctine, axial trace showing direction of plungs
		Tuscumbia Limestone, Fort Payne Chert, and Maury Formation		Fault, relative mavement not known
DEVONIAN	{	Cherrancogs Shale and	<u></u>	Normal fault: U, upthrown side: O, downthrown side
		Frog Mountain Sendstone	•	U, downthrown sige
SILURIAN	(==	Red Mountain Formation		Thrust fault, T on upper plate
		Chickemouge Limestone		Fault, showing relative horizontal movement
ORDOVICIAN		Attalla Chart Conglomerate Member: Chickensuse Limestone	4.4	Reverse fault, R on upthrown side
				Strike and dip of bads
		Ordovician undifferentiated	4	Strike and dip of overturned bads
		Knox Group undifferentiated	-	Strike of vertical bade
CAMBRIAN		Ketone Dolomite	•	Morizontal bade
CAMERIAN	ايا	Consssues Formation	_	Contact of geologic units, dotted where concessed
	رك	Rome Formetien	\odot	Fault reference number
		Formation symbol analoged in perentheses where formation is concealed.	Ö	Fold reference number

The illustrated symbols do not necessarily appear on all maps.

Faults, synalines and entiglines are deshed where inferred; dotted where concealed.



QUATERNARY		Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY		High terrate deposits Possible terrace of questionable age		Lineaments from U.S. Geological Survey 714-minute orthophotoquesis, 1975.
CRETACEOUS	{ 🖫	Caker Formetion: Tueceloose Group		Lineaments from National Aeronautics and Space
PENNSYLVANIAN	{ 💽	Fattsville Formetion		Administration High-eltitude color-infrared photography, February 22, 1973.
	—	Parkwood Formation	+	Anticline, axiel trace
		Floyd Shele	+	Amidine, axial trace showing direction of plunes
MISSISSIPPIAN		Bengor Limestone	<u></u>	Synetine, axial trace
mississiff (AR		Hortselle Sandetone		Synatine, sxiel trace
		Fride Mountain Formation	•	showing direction of plungs
	1000	Tuecumbie Limestone, Fort Payne Chert, and Meury Formstion		Fault, reletive movement not known
DEVONIAN	{	Chattanoogs Shale and Frog Mountain Sandstone	<u></u>	Normal fault: U, upthrown side: D, downshrown side
SILURIAN	=	Red Mountain Formation		Thrust fault, T on upper plate
		Chickensuge Limestone		Fault, showing relative horizontal movement
ORDOVICIAN	2	Attalla Chert Conglomerate Member: Chickemeuse Limestone		Reverse fault, R on upthrown side
		Ordovician undifferentiated	,	Strike and dip of bods
		Knox Group undifferentiated	4	Strike and dip of overturned beds
		Ketone Oolgmite		Strike of vertical bads
CAMBRIAN	1	Conssauge Fermetien		Horizontal bads Contact of stolesis units, dotted where concessed
		Rome Formation	$\widetilde{\Omega}$	Foult reference number
		Formation symbol enclosed in parentheses where formation is conceeded.) [Fold reference number
	_		· •	Souther manifesta and postations are derived

The illustrated symbols do not necessarily appear on all maps.

Faults, synelines and enticlines are deshed where inferred; detted where concessed.

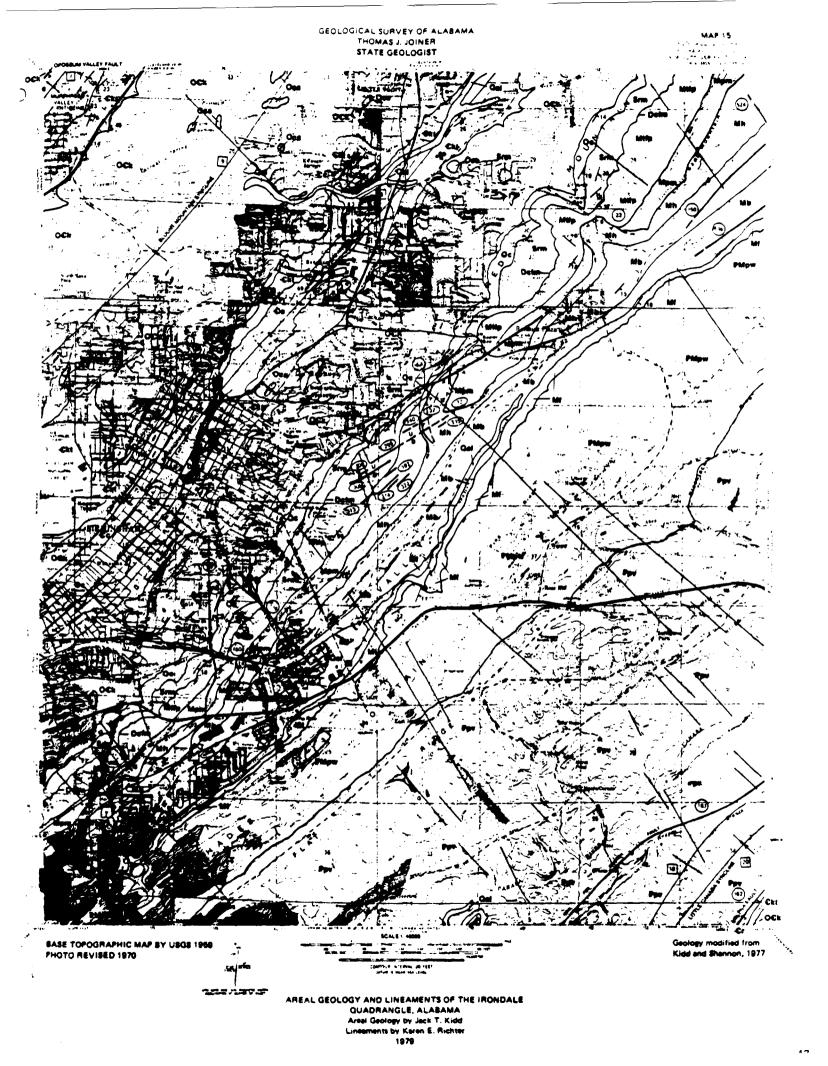
GEOLOGICAL SURVEY OF ALABAMA THOMAS J. JOINER STATE GEOLOGIST BASE TOPOGRAPHIC MAP BY USGS 1958 Geology modified from PHOTO REVISED 1970 Kidd and Shennon, 1977

AREAL GEOLOGY AND LINEAMENTS OF THE BIRMINGHAM NORTH
QUADRANGLE, ALABAMA
Areal Geology by Jack T. Kidd
Lineaments by Karen E. Richter
1979

		Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY	✓ Image: square of the property of the	High terrace deposits		
		Possible terrace of questionable ass		Lineaments from U.S. Geological Survey 7%-minute orthophetogueds, 1978.
	}	4		Annual Computation, 1919.
CRETACEOUS	ξ [K •]	Coller Formation: Tuessloose Group		Lineaments from National Aeronautics and Space
PENNSYLVANIAN	₹	Pottsville Formetlan		Administration High-etitude color-infrared photography, February 22, 1973.
	-	Parlamont Formation	•	Academic
		Per RWOOS PORTISTION		Anticline, exiel trace
		Floyd Shele		Anticline, sxisi trace
		Bengor Limestone	•	showing direction of plungs
MISSISSIPPIAN		Marsan Octobra		Syncline, exial trace
		Hertselle Sendetone	į.	Synctine, exist trace
		Fride Mountain Formation	+	showing direction of plunge
	I	Tuscumble Limestone, Fort Payne		Fault, relative movement not known
	(Chert, and Meury Formation		
DEVONIAN	(Date)	Chettanoogs Shale and		Normal fault: U, upthrawn side:
000000	ì	Freg Mountain Sendstone	-5	D, downthrown side
SILURIAN	{	Red Mountain Formation		Thrust fault, T on upper plats
	}	Claboration Limited		Foult, showing reletive horizontal movement
	اتا	Chickamauga Limestone		
ORDOVICIAN	-	Attalle Chert Conglomerate		Reverse fault, R en upshrown side
		Member: Chickemouge Limestone		Strike and dip of bods
	0	Ordevision undifferentieted	<u>م</u>	Strike and die of everturned heds
	} □	Knox Group undifferentiated	•	Child Sid Sid at a containing bear
		Marina Batanta	+	Strike of vertical bods
CAMBRIAN		Ketone Delamite	•	Horizontal bads
COMBUIAN	افا	Consisuge Fermation		Contest of espicate units, decred where consessed
		Rome Fermetien	\sim	
	,—	English and an about to a second	$\odot \odot$	Foult reference number
		Formation symbol enclosed in perentheses where formation is concepted.	F1-	Fold reference number

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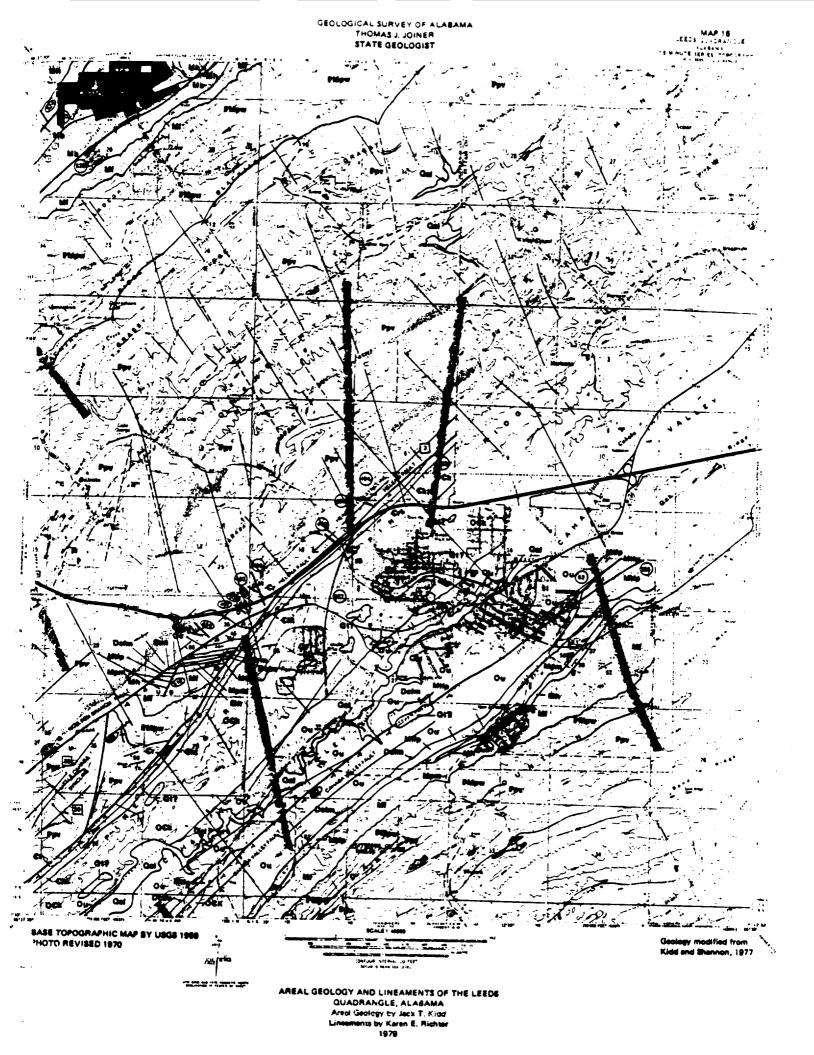
Faults, synalines and anticlines are deshed where inferred; detted where concessed.



		Alluvium and low terrace deposits		Lineaments from LANOSAT band-6 print, February 1977.
CHARRETAUD	⟨ □	High terruce deposits		
		Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minuts orthophotoquede, 1975.
CRETACEOUS	{ 🐷	Color Formation: Tuessions Group		Lineaments from National Aeronautics and Space
PENNSYLVANIAN	₹	Pottsville Formstion	-	Administration High-eltitude color-infrared photography, February 22, 1973.
	——	Perkwood Formetion	+	Anticline, axial trace
		Floyd Shale		Anticline, exist trees showing direction of plunes
		Bengor Limestone	·	anoming an action of breings
MISSISSIPPIAN	₹ 	Hertselle Sendstone		Syncline, axial trace
			+	Synctine, axial trace
		Pride Mountain Formation	•	showing direction of plungs
	1	Tuscumbia Limestone, Fort Payne Chert, and Meury Formation		Fault, relative movement not known
DEVONIAN	{ []	Chettanooge Shele and		Normal fault: U, upthrown side:
	رست	Frog Mountain Sandstone	0	D, downthrown side
SILURIAN	{ E	Red Mountain Formation	4 4	Thrust fault, T on upper plate
		Chickamouge Limestone		Fault, showing reletive harizontal movement
		Attalla Chert Conglomerate	4.4	Reverse fault, R on upthrown side
ORDOVICIAN		Member: Chickamauge Limestone		Strike and dip of bads
	اقا	Ordevicion undifferentiated	4	Strike and dip of overturned balls
		Knox Group undifferentiated		Strike of vertical bads
		Kerone Dolemite	•	Horizontal bads
CAMBRIAN	ا	Considues Formation	_	Contest of geologic units, dotted where concealed
		Rome Formetien	\odot	Foult reference number
		Formation symbol enclosed in parentheses where formation is concested.) []	Fold reference number

The illustrated symbols do not necessarily appear on all maps.

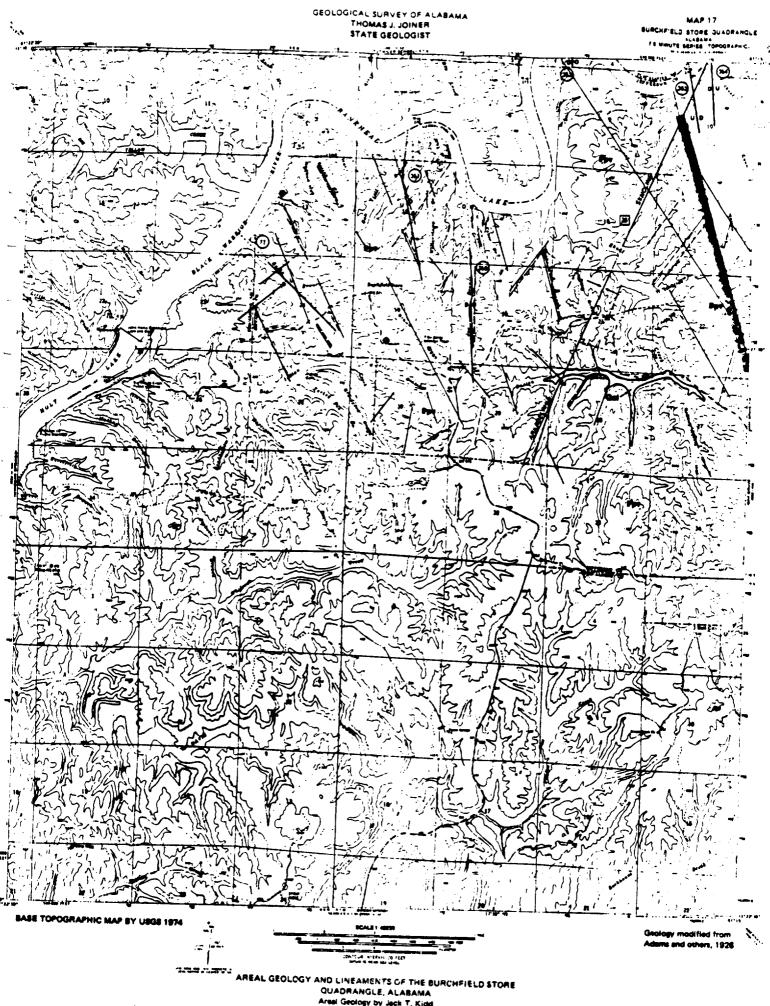
Faults, synalines and entidines are deshed where inferred; dotted where concested.



			Alluvium and low terrace deposits		Lineaments from LANOSAT bend-6 print, February 1977.
QUATERNARY	1		High terrace deposits		
	ļ	Ou/	Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoqueds, 1975.
CRETACEOUS	{	Ke	Coker Formation: Tuscalooss Group		Lineaments from National Aeronautics and Space Administration High-attitude color-infrared photography,
PENNSYLVANIAN	{	(Ppr	Pattsville Formation	~	February 22, 1973.
	ſ		Parkwood Formation		Anticline, exiel trace
		•	Floyd Shale		Anticline, exiet trace showing direction of plunes
	1	100	Bangor Limestone	1	
MISSISSIPPIAN	{		Hertselle Sandstone	1	Syncline, sxiel trace
	1				Synctine, exial trace
	-		Pride Mountain Formation	₹	showing direction of plunge
		••••	Tuscumbia Limestone, Fort Payne Chert, and Maury Formetion		Fault, relative movement not known
	`.				
DEVONIAN	₹	Deten	Chattenoogs Shale and	<u></u> _	Normal fault: U, upthrown side:
	l	لتتتا	Frog Mountain Sendstone	0	D, downthrown side
SILURIAN	{	\$	Red Mountain Formation	4 4	Thrust fault, T on upper plate
	ſ	<u>•</u>	Chickemouge Limestone	~	Fault, showing relative horizontal movement
ORDOVICIAN	Į	G	Attalla Chart Conglomerate Member: Chichamause Limestone		Reverse feult, R on upthrown side
		<u></u>	Ordovician undifferentiated		Strike and dip of bods
	ļ		Knex Grove undifferentiated	4	Strike and dip of overturned bads
				-+-	Strike of vertical bads
CAMBRIAN	Į		Keene Dolomite	•	Horizontal bade
	1		Consseuge Formation		Contact of goologic units, dotted where concealed
	l	لثا	Rome Formation	\odot \odot	Fault reference number
•			Formation symbol enclosed in perentheses	$\tilde{-}$	fine and the second sec
			where formation is consected.		Fold reference number
					Faults, synalines and entidines are deshed

The illustrated symbols do not necessarily appear on all maps.

Faults, synalines and entiellnes are deshed where inferred; dotted where concested.



Areal Geology by Jack T. Kidd Lineaments by Karen E. Richter

		Alluvium and low terrace deposits		Lineaments from LANOSAT band-6 print, February 1977.
QUATERNARY	{ <u>a</u>	High terrace deposits		
	Oe?	Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoqueds, 1975.
CRETACEOUS	{ 🐷	Coker Formation: Tuscaloose Group	ممر	Lineaments from Netional Aeronautics and Space Administration High-etitude color-infrared photography
PENNSYLVANIAN	₹ • • • • • • • • • • • • • • • • • • •	Pottsville Formation		February 22, 1973.
	T	Perkwood Formation	+	Anticline, axial trace
		Floyd Shale		Anticline, sxist trace
•		Sengor Limestone	•	showing direction of plunge
**********			_ <u>+</u> -	Synctine, sxiel tress
MISSISSIPPIAN		Hertselle Sandstone	T	
	1	Pride Mountain Formation	- •	Synctine, exial trace showing direction of plunes
			'	
	Mete	Tuscumbia Limestone, Fort Payne		Fault, relative movement not known
	(Chert, and Meury Formetion		
DEVONIAN	{ Defm	Chattangogs Shale and		Normal fault: U, upthrown side:
	رسار	Frog Mountain Sandstone	0	D, downthrown side
SILURIAN	{	Red Mountain Formation	- -	Thrust fault, T on upper plate
	(a	Chickameuga Limestone	-	Fault, showing relative horizontal movement
ORDOVICIAN		Attalla Chert Conglomerate	<u> </u>	Reverse fault, R on upthrown side
ONDOTICIAN)	Member: Chickamauge Limestone		Strike and dip of beds
		Ordovician undifferentiated	4	Strike and dip of overturned bads
	ر معام	Knox Group undifferentiated	-	Strike of vertical bads
	-	Ketone Colomite	•	Horizontal bade
CAMBRIAN	1	Conssues Fermation	•	Traper appropriate provider
				Contact of geologic units, dotted where conceeled
	رك	Rome Formetion		Fault reference number
		Formation symbol enclosed in parentheses		<u> </u>
		where formation is conceeled.	Ŀ	Fold reference number
_				m a. M. a. a. M

The illustrated symbols do not necessarily appear on all mags.

round, synchines and ambients are delined where inferred; dected where concested.

MAP 18
YOLANDE NORTHWEST JULIORANGLE
ALABAMA
UNEDITED ADVANCED FRINT
7.6 MINUTE SERIES (TOPOGRAPHIC) GEOLOGICAL SURVEY OF ALABAMA
THOMAS J. JOINER STATE GEOLOGIST LIVALIN BASE TOPOGRAPHIC MAP BY USGS 1976 UNEDITED ADVANCED PRINT Geology modified from Adams and others, 1926 AREAL GEOLOGY AND LINEAMENTS OF THE YOLANDE NW

QUADRANGLE, ALABAMA Areal Geology by Jack T. Kidd Lineaments by Karen E. Richter 1979

	=	•	Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY	٢L	œ	High terraca deposits		
	١٠	Ost?	Possible terrece of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoqueds, 1975.
CRETACEOUS	$\{ \Box$	Ke	Coker Formation: Tuscalgosa Group		Lineaments from National Aeronautics and Space
PENNSYLVANIAN	{ [794	Pottsville Formation		Administration High-altitude color-infrared photography, February 22, 1973.
	} •	No-	Parkwood Formation	+	Anticline, exiel trace
		**	Floyd Shale		Anticline, exiet trace
			Bengor Limestone	*	showing direction of plungs
MISSISSIPPIAN	J는		Hertseile Sandstone	+	Synctine, axiel trace
	1 =	=			Syncline, axial trace
			Pride Mountain Formation		showing direction of plunge
		dedp.	Tuscumbia Limestons, Fort Psyne Chert, and Maury Formation		Fault, relative movement not known
	1		Chattanoogs Shale and	U	Normal fault: U, upthrown side:
DEVONIAN	1 L	-	Froe Mountain Sendstone		O, downthrown side
SILURIAN	{[•	Red Mountain Formation		Thrust fault, T on upper plate
	ſ	O a	Chickeneuge Limestone		Fault, showing relative horizontal movement
			Attalla Chert Conglomerate		Reverse fault, R on upthrown side
ORDOVICIAN			Member: Chickemauge Limestone		Strike and dip of beds
		<u>-</u>	Ordovician undifferentiated	4	Strike and dip of overturned bads
	ياز	<u> </u>	Knox Group undifferentiated	-	Strike of vertical bade
		9 k:	Ketone Dolemite	•	Monizontal bada
CAMBRIAN	1 C	•	Consseuge Formation		Contact of exclusis units, dotted where concealed
		•	Rome Fermation	\bigcirc	Fault reference number
•			Formation symbol enclosed in perentheses		
			where formation is concealed.		Fold reference number
	•				Faults, syndines and entidines are deshed

The illustrated symbols do not necessarily appear on all mage.

Faults, syndlines and antidines are deshed where inferred; dotted where concested.



		Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY	✓ ✓	High terrase deposits		
	(a)	Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoqueds, 1975.
CRETACEOUS	{ Ke	Coker Formation: Tuscaloosa Group		Lineaments from National Aeronautics and Space
PENNSYLVANIAN	₹	Pottsville Formation	,	Administration Migh-eltitude color-infrared photography, February 22, 1973.
		Parkwood Formation		Anticline, exial trace
	-	Floyd Shale		Anticline, axiel trace showing direction of plungs
	1	Bangor Limestone	•	and the second of the second
MISSISSIPPIAN	∤ 🔄	Hartselle Sandstone		Syncline, axial trace
		- · · · · · · · · · · · · · · · · · · ·		Synctine, axiel trace
		Pride Mountain Formation	*	showing direction of plunge
		Tuscumbis Limestone, Fort Peyne Chert, and Meury Formstion		Fault, relative movement not known
	/	Chettanooss Shale and	v	Normal fault: U, upthrown side:
DEVONIAN	(Description	Frog Mountain Sandstone	-	D, dawnthrown side
SILURIAN	{•••	Red Mountain Formation	44	Thrust fault, T on upper plate
		Chickemeuge Limestone		Fault, showing relative horizontal movement
ORDOVICIAN		Attalla Chert Conglomerate	هــهـ	Reverse fault, R on upthrown side
ONDOVICIAN		Member: Chickemouge Limestone	~	Strike and dip of bads
		Ordovicien undifferentiated	4	Strike and dip of overturned bads
CAMBRIAN		Knex Group undifferentiated	-+-	Strike of vertical bads
		Ketone Delemite Consissings Fermation	•	Horizontal bada
	1			Contest of geologic units, detted where concessed
		Rome Fermation	$\widetilde{\mathbb{Q}}$	Fault reference number
	-	Formation symbol enclosed in parantheses		· Santa raria sinda dan asar
		where formation is concealed.	⊡	Fold reference number
	•			Faults, synctines and enticlines are deshed

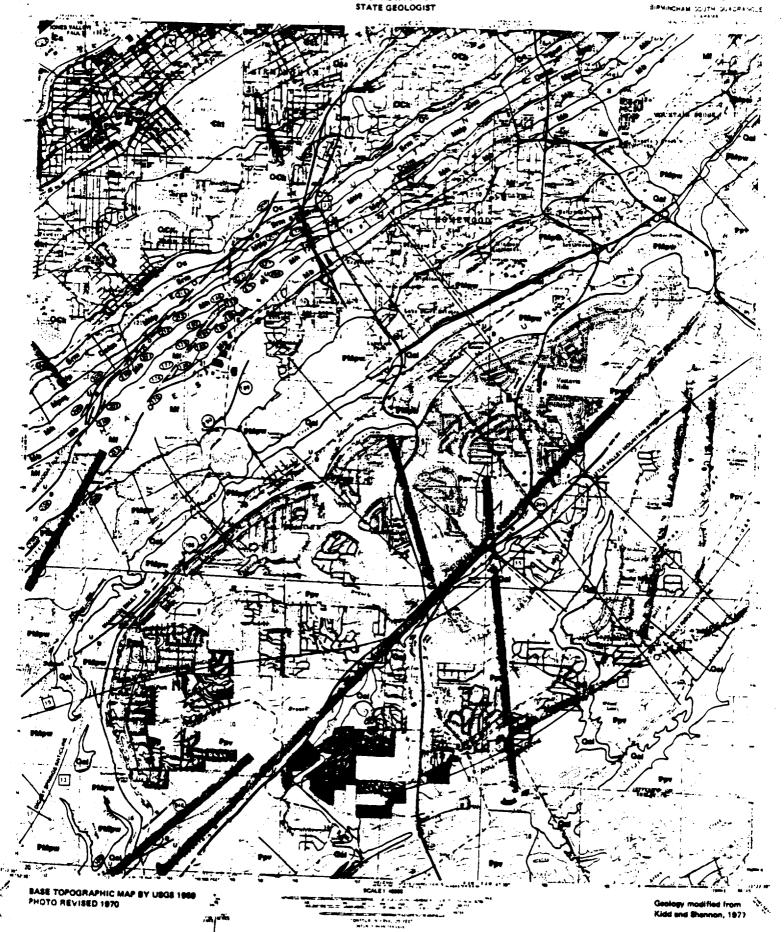
The illustrated symbols do not necessarily appear on all maps.

where inferred; detted where concested.

		Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY	⟨ On]	High terrace deposits		· · · · · · · · · · · · · · · · · · ·
			/	Lineaments from U.S. Geological Survey
	ا تعا اِ	Possible terrace of questionable age		7%-minute orthophotoqueds, 1976.
CRETACEOUS	{ 🐷	Column Formation: Tuscalooss Group	مر	Lineaments from National Aeronautics and Space Administration High-essitude color-infrared photography.
PENNSYLVANIAN	₹	Pottsville Formation	-	February 22, 1973.
	} ===	Parkwood Formation	+	Anticline, exial trace
		Floyd Shale	-	Anticline, axial trace showing direction of phunes
		Bangor Limestone		sioning direction or provide
MISSISSIPPIAN			 -	Synctine, exist trace
M-19919817 1744	\ <u></u>	Hertselle Sandstone	Ţ	
		Pride Mountain Formation	-	Syncline, axial trace showing direction of plunes
			т	mounty direction of biggs
		Tussumble Limestone, Fort Payne		Fault, relative movement not known
	(=====================================	Chert, and Meury Formation		
		Chattenoons Shele and	U	Normal fault: U, upthrown side:
DEVONIAN	{ Destail	From Mountain Sendstone		D, downthrown side
	<u>`</u>			
SILURIAN	{ }	Red Mountain Formation	4 4	Thrust fault, T on upper plate
	7	*** * *** * * * * * * * * * * * * * *		Fault, showing reletive horizontal movement
		Chickemouge Limestone		•
		Attalle Chert Conglomerate	عـد	Reverse fault, Fl en upskrown side
ORDOVICIAN	⟨ ြ	Member: Chickenouge Limestone	 -	
			•	Strike and dip of bads
		Ordevicien undifferentisted	4	Strike and die of overturned bads
) OGR	Knox Group undifferentimed		
				Strike of vertical bade
		Kerens Delemite	•	Mandage and backs
CAMBRIAN	√ [•]	Consume Samuelan	•	Herisontal beds
		Consumus Fermation		Correct of goologic units, docted where concealed
		Rame Fermation		
	,—	• • • • • • • • • • • • • • • • • • • •	$\odot \odot$	Fault reference number
•		Formation symbol enclosed in parentheses where formation is concepted.	Ō	Fold reference number
		The state of the s		
				Faults, susuitable and potentions are deshed

The illustrated symbols do not necessarily appear on all maps.

Faults, synafines and antictines are deshed where inferred; dested where conceeled.



AREAL GEOLOGY AND ILINEAMENTS OF THE BIRMINGHAM SOUTH
QUADRANGLE, ALABAMA
Areal Coolugy by Jack T. Kidd
Ilineaments by Karen E. Richter
1979

		Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY	([]	High terrace deposits	•	
	(a)	Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoquads, 1975.
CRETACEOUS	<u> </u>	Coker Formation: Tuscalcoas Group	ممر	Lineaments from Netional Aeronautics and Space Administration High-attitude color-infrared photography.
PENNSYLVANIAN	⊡	Pottsville Formation		February 22, 1973.
		Parkwood Formation	+	Anticline, sxiel trace
		Floyd Shale		Anticline, sxiat trace showing direction of plungs
		Bengor Limestone	_ •	• • • • • • • • • • • • • • • • • • • •
MISSISSIPPIAN	⟨ Б	Hartselle Sandstone	1	Syncline, exist trace
				Synctine, axial trace
		Pride Mountain Formetion	1	showing direction of plungs
	1	Tuscumble Limestone, Fort Payne Chert, and Meury Formation		Fault, relative mevement not known
DEVONIAN	{ Date	Chettanoogs Shale and Froe Mountain Sandstone	_	Normal fault: U, upthrown side: D, downthrown side
SILURIAN	(Red Mountain Formation	77	Thrust fault, T on upper plate
		Chickemouge Limestone	-	Fault, showing relative horizontal movement
ORDOVICIAN	000	Attalla Chert Conglomerate	<u> </u>	Reverse fault, R on upthrown side
		Member: Chickemauge Limestone		Strike and dip of bade
		Ordovision undifferentiated	Ą	Strike and dip of overturned bads
CAMBRIAN		Knax Group undifferentiated	-+-	Strike of vertical bads
		Ketene Dolomite	•	Horizontal bada
	10	Consssuge Formation		Contact of gaologic units, dotted where concepted
		Rome Formation	\odot	Fault reference number
		Formation symbol enclosed in parentheses where formation is concealed.		Fold reference number
	•	•	_	Faults, synatines and anticlines are deshed

The illustrated symbols do not necessarily appear on all maps.

where inferred; dotted where concluded.

MAP EXPLANATION¹

		Alluvium and low terrace deposits	_	Lineaments from LANDSAT bend-6 print, February 1977.
QUATERNARY	< ○ □	High terrace deposits		Tourism Timer.
	Qe?	Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoquads, 1975.
CRETACEOUS	{ Ke	Coker Formetion: Tuscaloosa Group		Lineaments from National Aeronautics and Space
PENNSYLVANIAN	{ P	Pottsville Formation		Administration High-eltitude color-infrared photography, February 22, 1973.
	Phon	Parkwood Formation	-	Anticline, axial trace
	•	Floyd Shate		Anticline, exial trace
		Sangor Limestone	•	showing direction of plungs
MISSISSIPPIAN		Hertselle Sandstone	-	Synctine, axial trace
			•	Synctine, axial trace
	1	Pride Mountain Formation		showing direction of plungs
	Melip	Tuscumbia Limestone, Fort Payne Chert, and Meury Formation		Fault, relative movement not known
DEVONIAN	/ ()	Chattanooge Shale and		Normal fault: U, upthrown side:
OE TOTTIAL	(Com	Frog Mountain Sendstone		D, downthrown side
SILURIAN	{ •	Red Mountain Formation		Thrust fault, T on upper plate
		Chickamauge Limestone	-	Fault, showing relative horizontal movement
ORDOVICIAN	J 🚗	Attalla Chert Conglomerate	<u> </u>	Reverse fault, R on upthrown side
ONDOVICIAN		Member: Chickamaugs Limestone		Strike and dip of beds
		Ordovicien undifferentiated	4	Strike and dip of overturned beds
CAMBRIAN	(00	Knox Group undifferentiated	-	Strike of vertical bads
		Ketone Dolomite	•	Horizontal bads
		Consseuge Formation	_	Contact of geologic units, dotted where concealed
		Reme Fermetion	\bigcirc	Fault reference number
•		Formation symbol enclosed in parentheses where formation is senousied,	0	Fold reference number

The illustrated symbols do not necessarily appear on all maps.

Faults, synclines and anticlines are deshed where inferred; dotted where concessed.

MOIVER

GEOLOGICAL SURVEY OF ALABAMA

		a	Alluvium and low terrace deposits		Lineaments from LANOSAT band-8 print, February 1977,
QUATERNARY	\	œ	High terrace deposits		Lineaments from U.S. Geological Survey
	<u>ا</u> إ	Qu?	Possible terrace of questionable age		7%-minute arthophotoquads, 1975.
CRETACEOUS	{[Ke	Coker Formation: Tuscaloose Group	200	Lineaments from National Aeronautics and Space Administration High-altitude color-infrared photography,
PENNSYLVANIAN	{ [***	Pottsville Formation		February 22, 1973.
	ام	PMpw	Parkwood Formation		Anticline, axial trace
] [**	Floyd Shale	-	Anticline, exial trace
	1	140	Bangor Limestone	•	showing direction of plunge
MISSISSIPPIAN	$\{i$	140	Hartselle Sendstone	•	Syncline, axial trace
	ſ	Mpan	Pride Mountain Formation		Synctine, axial trace
	1		Fride Modintain Formerion	т	showing direction of plunge
	ľ	Mede	Tucumbia Limestone, Fort Payne		Fault, relative movement not known
	('		Chert, and Meury Formation		
DEVONIAN	1	Detm	Chattanoogs Shale and		Normal fault: U, upthrown side:
	Ţ		Frog Mountain Sendstone	D	D, downthrown side
SILURIAN	{[3rm	Red Mountain Formation	44	Thrust fault, T on upper plate
		0 •	Chickemauge Limestone	-	Fault, showing relative horizontal movement
ORDOVICIAN		Qua	Attalla Chert Conglomerate	<u> </u>	Reverse fault, R on upthrown side
);		Member: Chickemeuge Limestone		Strike and dip of beds
	إ	<u>~</u>	Ordovician undifferentiated	4	Strike and dip of overturned bads
CAMBRIAN	إ	OE2	Knex Group undifferentiated	—	Strike of vertical bads
	اا		Ketone Delomite	•	Marizontal bada
	\ 	••	Concesuge Formetion		Contact of geologic units, dotted where consected
	U	•	Reme Formation	\odot	Foult reference number
•			Formation symbol anclosed in perentheses		Political construction
			where formation is concealed,	ت ا	Fold reference number
	•				Faults, synctines and enticlines are deshed

The illustrated symbols do not necessarily appear on all maps.

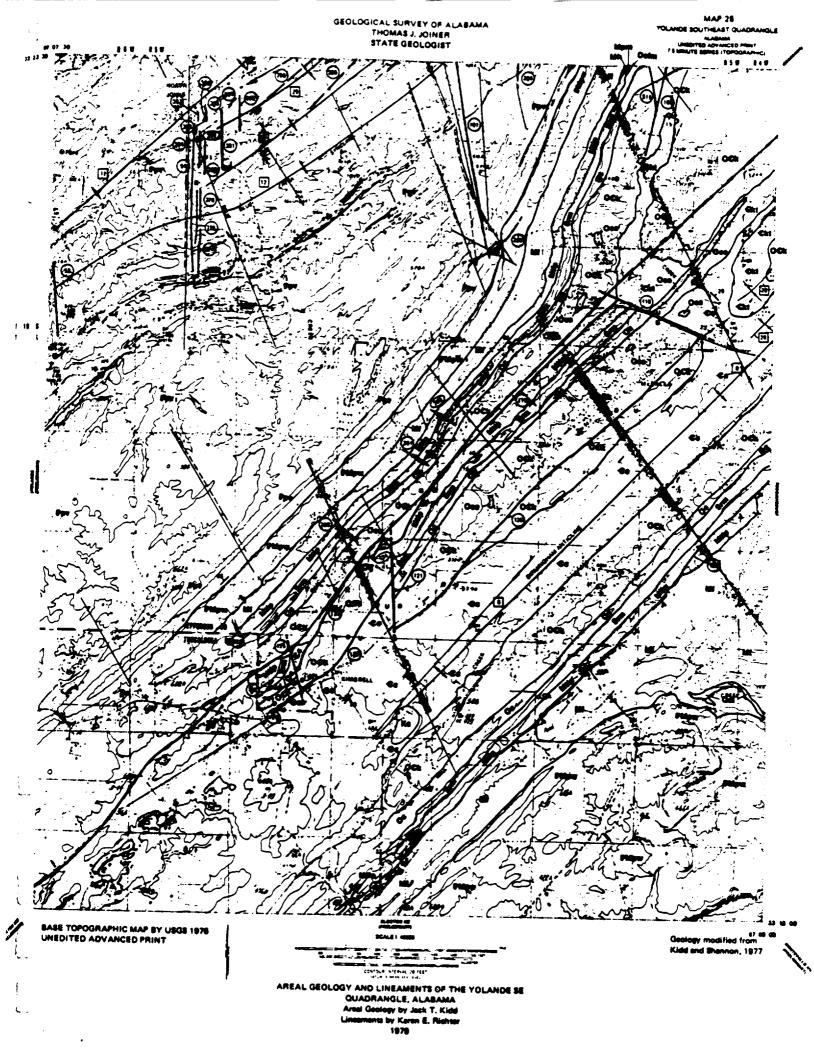
Faults, synclines and anticlines are deshed where inferred; dotted where concessed.

AREAL GEOLOGY AND LINEAMENTS OF THE YOLANDE SW QUADRANGLE, ALABAMA Areal Geology by Jeck T. Kidd Lineaments by Keren E. Riehter 1978

		Alluvium and low terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
QUATERNARY		High terrace deposits		Lineaments from U.S. Geological Survey
	} •••	Possible terrace of questionable age		7%-minute orthophotogueds, 1975.
CRETACEOUS	\ <u></u>	Coker Formation: Tuscaloose Group	ممر	Lineaments from National Aeronautics and Space Administration High-eltitude color-infrared photography.
PENNSYLVANIAN	₹	Pottsville Formetion		February 22, 1973.
	77000	Parkwood Formation	-	Anticline, axial trace
		Floyd Shale		Anticline, axial trace showing direction of plunes
		Banger Limestone		Syncting, axial trace
MISSISSIPPIAN		Hartseile Sandssone	†	Synctine, axial trace
		Pride Mountain Formation	-	showing direction of plungs
	Nee	Tuscumbis Limestone, Fort Payne Chert, and Maury Formetion		Fault, relative movement not known
DEVONIAN	/ [Chettanoogs Shale and		Normal fault: U, upthrown side:
oc voitani	\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \	Frog Mountain Sendstone	0	D, downthrown side
SILURIAN	(Red Mountain Formation		Thrust fault, T on upper plate
	O	Chickemouge Limestone		Fault, showing relative horizontal movement
ORDOVICIAN	-	Attalla Chert Conglomerate	44	Reverse fault, R on upthrown side
UNDO VIOLAN		Member: Chickemauge Limestone		Strike and dip of bads
		Ordovician undifferentiated	4	Strike and dip of overturned bads
	(((((((((((((((((((Knox Group undifferentiated	-+-	Strike of vertical bade
CAMBRIAN		Ketone Dolomite	•	Horizontal bads
		Concesuge Formation		Californ of geologic units, detted where conscied
	راگا	Rome Fermetien	$\odot 0$	Foult reference number
•		Formation symbol enclosed in perentheses where formation is conceeled.		Fold reference number
				Faults, synalines and anticlines are deshed

The illustrated symbols do not necessarily appear on all maps.

Faults, synetines and anticlines are deshed where inferred; dotted where conceeled.

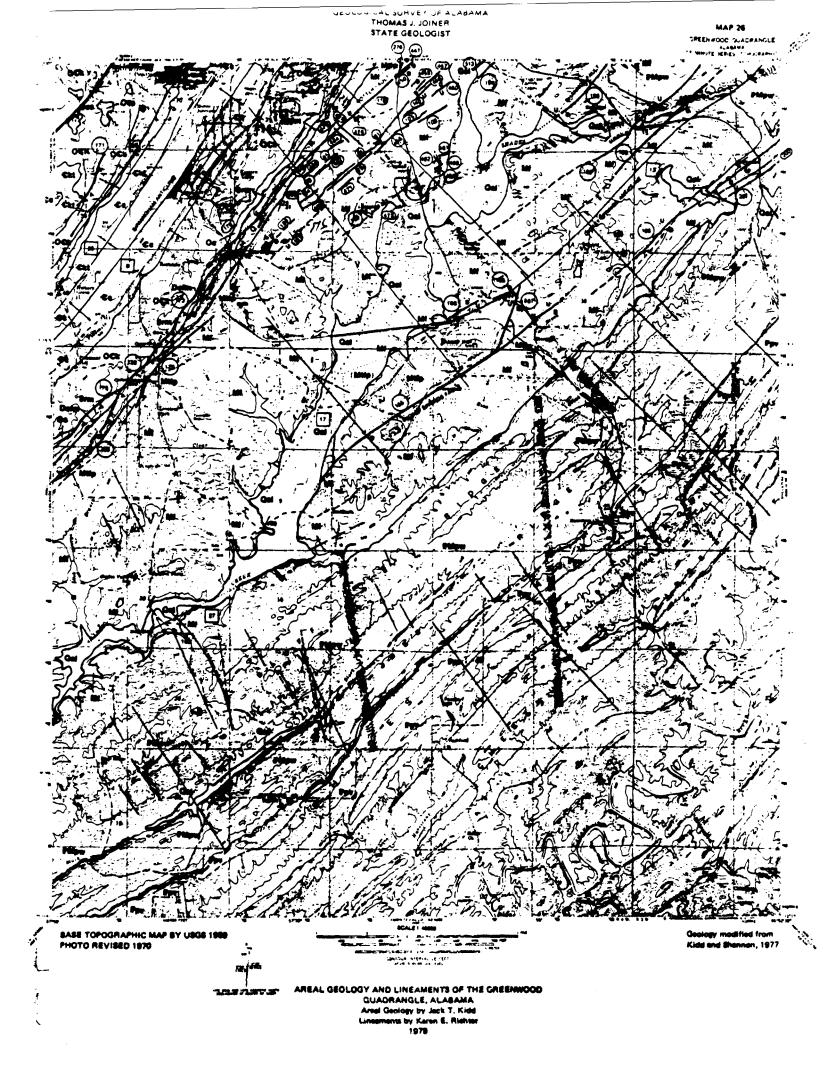


MAP EXPLANATION

QUATERNARY		Alluvium and low terrace deposits High terrace deposits		Lineaments from LANDSAT band-6 print, February 1977.
		Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoqueds, 1976.
CRETACEOUS	₹ 🐷	Coller Formation: Tuessiooss Group	مر	Lineaments from Netional Aeronautics and Space Administration High eltitude color-infrared photography.
PENNSYLVANIAN	=	Pottsville Formation	7	February 22, 1973.
	}	Parkwood Formation	-	Anticline, exial trace
		Floyd Shale	-	Anticline, exial trace showing direction of plunes
	-	Sengor Limestone	Ĭ	monning direction or printing
MISSISSIPPIAN	∤ 🛅	Hartselle Sandstone	+	Synctine, exist trace
		Fride Mountain Formation	+++	Synctine, axial trace
		Pride Mountain Formation	•	showing direction of plungs
	-	Tuscumble Limestone, Fort Payne Chert, and Maury Formation		Fault, relative movement not known
DEVONIAN	⟨ □	Chattanoogs Shale and		Normal fault: U, upthrown side:
		Frog Mountain Sendstone	- 0	D, downthrown side
SILURIAN	=	Red Mountain Formation		Thrust fault, T on upper plats
		Chickemauga Limestone		Fault, showing relative horizontal movement
ORDOVICIAN		Attalla Chart Conglomerate	44	Reverse fault, R on upthrown side
ONDOVICIAN		Member: Chickemouge Limestone	~	Strike and dip of bads
	ري	Ordovician undifferentisted	4	Strike and dip of overturned bade
		Knex Group undifferentiated		Strike of vertical bads
		Ketone Dolomite	•	Horizontal bads
CAMBRIAN	1	Concesuge Formation		Contact of goologic units, detted where concealed
		Rome Formetion	\odot \odot	Fault reference number
•		Formation symbol enclosed in parentheses where formation is concealed.	0	Fold reference number
	•			Foults, synalines and anticlines are dashed

The illustrated symbols do not necessarily appear on all maps.

Foults, syndines and anticlines are deshed where inferred; dotted where conceeled.



MAP EXPLANATION

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		10771 1077		
		Alluvium and low terrace deposits		Lincoments from LANDSAT bend-6 print,
QUATERNARY	{	High terrece deposits		
		Possible terrace of questionable age		Lineaments from U.S. Geological Survey 7%-minute orthophotoqueds, 1976.
CRETACEOUS	{ Ka	Coker Formation: Tuscaloosa Group	.^	Lineaments from National Aeronautics and Space
PENNSYLVANIAN	₹	Pottsville Formation		Administration high-eltitude color-infrared photography, February 22, 1973,
	-	Parkwood Formation		Anticline, axiel trace
		Floyd Shele	•	Anticline, axial trace
		-		shawing direction of plungs
MISSISSIPPIAN		Bengor Limestone	<u></u>	Synctine, exial trace
		Hertselle Sandstone	į	Synctine, axial trace
	i i i	Pride Mountain Formation	-	showing direction of plungs
		Tuscumbia Limestone, Fort Payne Chert, and Meury Formation		Fault, relative movement not known
DEVONIAN	(Dates	Chattanoogs Shale and		Normal fault: U, upthrown side:
	رسار	Frog Mountain Sendstone	9	D, downthrown side
SILURIAN	=	Red Mountain Formation		Thrust fault, T on upper plate
		Chickemauge Limestone		Fault, showing relative horizontal movement
0000		Attalia Chert Conglomerate	ھھ	Reverse fault, R on upthrown side
ORDOVICIAN		Member: Chickamauge Limestone		Strike and dip of bads
	اگا	Ordovician undifferentiated	4	Strike and dip of overturned beds
		Knox Group undifferentiated		Strike of vertical bads
		Ketona Dolomite	•	Horizontal bads
CAMBRIAN	1	Consesuse Formation		Contact of sectoric units, dotted where concealed
		flome Formation	\bigcirc	Fourt reference number
•	•	Formetion symbol enclosed in perentheses where formetion is concealed.		Fold reference number
	_	with a contraction is contracted.	<u>U</u>	Foulte metalines and applaines are deshed

^{*}The illustrated symbols do not necessarily appear on all maps.

Faults, synatines and antielines are deshed where inferred; gotted where consessed.

DUADRANGLE, ALABAMA And Coology by Jack T, Kidd Lineaments by Keren E, Richest 1979 AREAL GEOLOGY AND LINEAMENTS OF THE HELENA SARUSUL. Geology modified from KTG1 , nannant bas bbly SASE TOPOGRAPHIC MAP BY USGS 1999 PHOTO REVISED 1970 MELENA GUADRANCLE ALABANA TRIDOJOBO BTATE GEOLOGICAL SURVEY OF ALABAMA
THOMAS J. JOINER LE AVN

Peprence NO. 13

Rite in the Rain. WEATHERPROOF

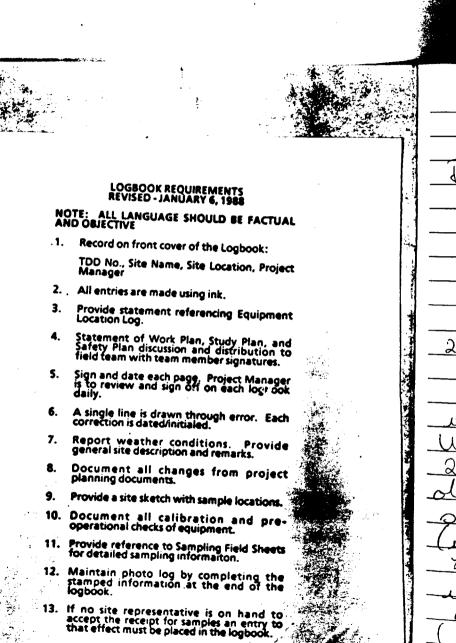
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NOTEBOOK NO. 311

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Birmingham Jefferson	
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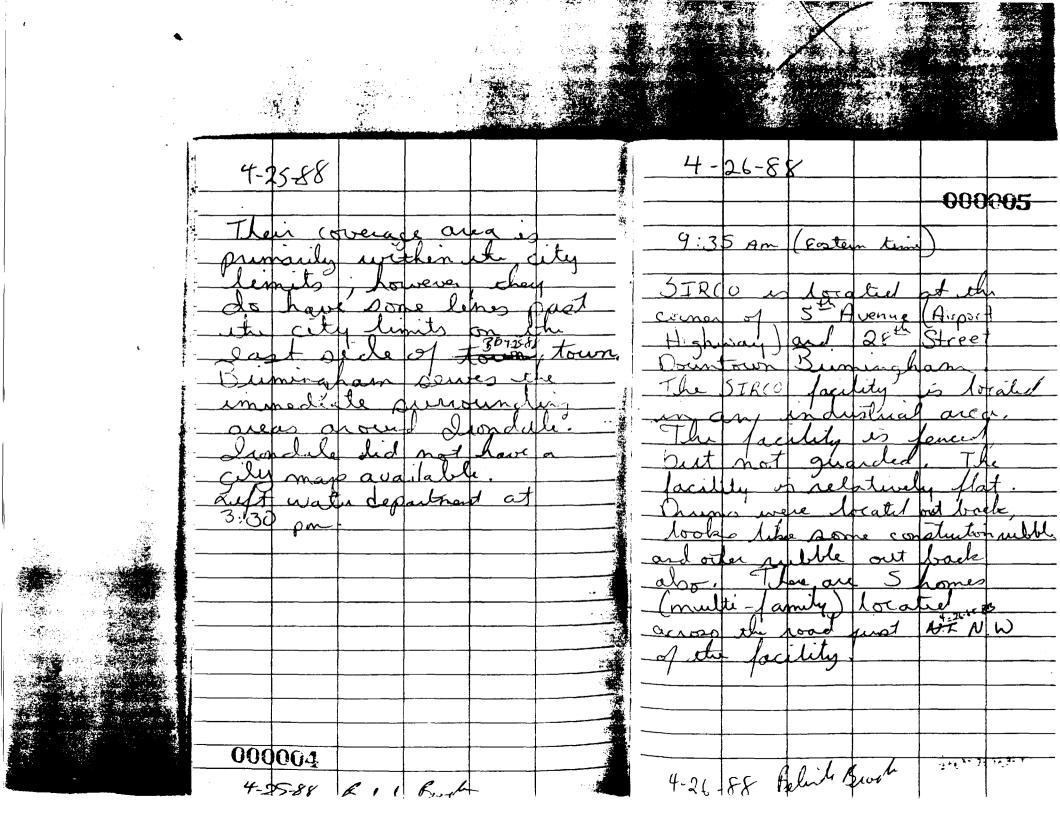
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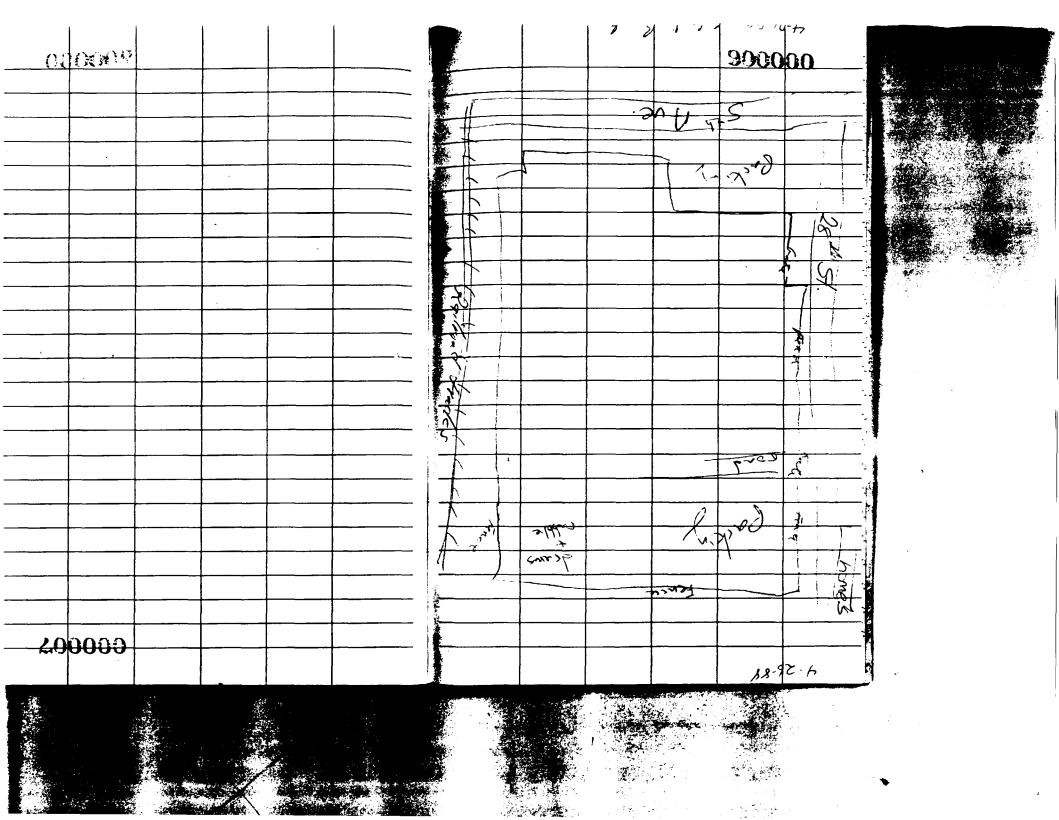
J. L. DARLING CORPORATION TACOMA, WASHINGTON 98421 U.S.A.



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CONTROL NO.

DATE: May 23, 1989

TIME: 10:00 a.m.

DISTRIBUTION: Blue Mud

TDO No. F4-8804-47

BETWEEN: Mr. Joe Downey

OF: ADEM

PHONE: (205) 271-7743

AND: Stephen Modica, NUS Corporation

57m 64-88

DISCUSSION:

Our discussion centered on industrial, municipal, and private wells; proximity to Village Creek; and , the dosest population. Industrial wells might be active (a few) but we did not discuss. There are no public or private wells in the 4-mile radius. Water is taken from Cahaba River and Lake Purdy (together approximately 60%) and the remainder is taken from Inland Lake and Lake Smith.

Village Creek is located 3/10 of a mile south of the facility. Primarily used for industrial and wastewater effluent.

Residential areas northeast of the facility. No groundwater use.



OVERSIZED DOCUMENT

MEGION: 04 STATE: AL

U.S. ENVIRONMENTAL PROTECTION AGENCY OFFICE OF EMERGENCY AND REMEDIAL RESPONSE C E R C L A

PAGE: 1560 RUN DATE: 85/06/03 RUN TIME: 19:06:17

M.2 - SITE MAINTENANCE FORM

	* ACTION: _ *
EPA ID: ALD054563887	
SITE NAME: SIRCO SYSTEMS INC SOURCE:	N * *
STREET: 2828 AIRPORT HWY CONG DIST: 06	*
CITY: BIRMINGHAM ZIP: 35204	* *
CNTY NAME: JEFFERSON CNTY CODE: 073	* *
LATITUDE: 33/31/06.0 LONGITUDE: 086/49/24.0	* _/_/
SMSA: 1000 HYDRO UNIT: 03160112	* *
INVENTORY IND: Y REMEDIAL IND: Y REMOVAL IND: N FED FAC IN	D: N * *
NPL IND: N NPL LISTING DATE: NPL DELISTING DATE:	*/_ *
AFPROACH: SITE CLASS:	* *
SITE/SPILL IDS:	* *
RPM NAME: RPM PHONE:	* *
DIOXIN TIER: REG FLD1: REG FLD2:	* *
RESP TERM: PENDING () NO FURTHER ACTION (X)	* PENDING (_) NO FURTHER ACTION (_) *
ENF DISP: NO VIABLE RESP PARTY () VOLUNTARY RESPONSE ()	* *
ENFORCED RESPONSE () COST RECOVERY ()	* *
SITE DESCRIPTION:	
	**
	* *
	* *
	* *

REGION: 04 STATE : AL

U.S. ENVIRONMENTAL PROTECTION AGENCY OFFICE OF EMERGENCY AND REMEDIAL RESPONSE C E R C L A

PAGE: 1561 RUN DATE: 85/06/03 RUN TIME: 19:06:17

M.2 - PROGRAM MAINTENANCE FORM

					* .	ACTION: _	,
SITE:	SIRCO SYST	EMS I	NC				
PA ID:	ALD0545638	87	PROGRAM CODE: HOI	PROGRAM TYPE:	×	_	,
ROGRAM	QUALIFIER:		ALIAS LINK :		* .		,
PROGRAM I	NAME:	SITE	EVALUATION		* .		,
ESCRIPT	ION:						
					* .		,
					* .		7
					* .		,
					* .		3

REGION: 04 STATE : AL

U.S. ENVIRONMENTAL PROTECTION AGENCY OFFICE OF EMERGENCY AND REMEDIAL RESPONSE C E R C L A

PAGE: 1562 RUN DATE: 85/06/03 RUN TIME: 19:06:17

M.2 - EVENT MAINTENANCE FORM

			* ACTION: _		*
SITE: SIRCO PROGRAM: SITE	SYSTEMS INC EVALUATION				
EPA ID: ALDOS	4563887 PROGRAM CODE: HO1	EVENT TYPE: DS1			
FMS CODE:	EVENT QUALIFIER:	EVENT LEAD: E	* _		_ *
EVENT NAME: D	ISCOVERY	STATUS:	*		_ *
DESCRIPTION:					
			*	······································	*
			*		*
			*		*
			*		*
ORIGINAL	CURRENT	ACTUAL			
START:	START:	START:	* _/_/_	_/_/_	_/_/_ *
COMP :	COMP :	COMP : 81/06/01	* _/_/_	_/_/_	_/_/_ *
HQ COMMENT:					
			*		*
RG COMMENT:					
			*		*
COOP AGR #	AMENDMENT # STATUS	STATE %			
			*		<u></u> *

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REGION: 04 STATE: AL

U.S. ENVIRONMENTAL PROTECTION AGENCY OFFICE OF EMERGENCY AND REMEDIAL RESPONSE C E R C L A

PAGE: 1563 RUN DATE: 85/06/03 RUN TIME: 19:06:17

M.2 - EVENT MAINTENANCE FORM

			* ACTION: _		*
SITE: SIRCO PROGRAM: SITE	SYSTEMS INC EVALUATION				
EPA ID: ALDOS	4563887 PROGRAM CODE: HOI	EVENT TYPE: PA1			
FMS CODE:	EVENT QUALIFIER:	EVENT LEAD: S	* _		_ *
EVENT NAME: P	RELIMINARY ASSESSMENT	STATUS:	*		_ *
DESCRIPTION:					
			*		×
			*		×
			*		*
			*		*
ORIGINAL	CURRENT	ACTUAL			
START:	START:	START: 84/08/01	* _/_/_	_/_/_	_/_/_ *
COMP :	COMP :	COMP : 84/08/01	* _/_/_	_/_/_	_/_/_ *
HQ COMMENT:					
RG COMMENT:			*		*
			*		*
COOP AGR #	AMENDMENT # STATUS	STATE %			
			*		*

REGION: 04 STATE: AL

U.S. ENVIRONMENTAL PROTECTION AGENCY OFFICE OF EMERGENCY AND REMEDIAL RESPONSE C E R C L A

PAGE: 1564 RUN DATE: 85/06/03 RUN TIME: 19:06:17

M.2 - COMMENT MAINTENANCE FORM

	m.2 - COMMENT P	MAINTENANCE FORM
SITE: SIRCO SYSTEMS INC		
EPA ID: ALD054563887		
COM NO COMMENT		ACTION
001 ALS000001068- SEE FILE		* _
		*

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT EPS FORM 3012-III

INDUSTRIAL NARRATIVE SHEET

1. Site Identification:

Site number: ALD054563887

Site name: Sirco Systems, Inc.

Site county: Jefferson County

Industrial Narrative Summary:

Company Name: Sirco Systems, Inc.

Address: 2828 5th Avenue North

Birmingham, AL 35204

Telephone No.: 205-254-3533

Contact: Ed Cain

Discussion: Sirco Systems, Inc. manufactures steel drum components. Jemison Investment Company purchased Sirco from Reynolds Metals in 1979. Land is leased from Reynolds Metals, Liberty National Insurance, Norfolk, Southern Railway, and Walker C. Madison.

Sirco produces approximately fifteen drums per year of wash-up solvent waste from roll coat painting. Sirco has recycled the solvent waste with Allworth, but Allworth has told Sirco they could no longer take their waste without a generator EPA I.D. number. Sirco is in the process of obtaining a number.

To the best of their knowledge, there has been no on-site dumping activity.

3. Disposition:

No further action.

4. Comments:

9	F	ΡΔ
	_	

POTENTIAL HAZARDOUS WASTE SITE

I. IDENTIFICATION

PART	ASSESSMENT ATION AND ASSESSMENT			AL	D 054363887		
II. SITE NAME AND LOCATION							
0.1 SITE NAME (Legal, common, or descriptive name of site)		02 STREE	T, ROUTE NO., OR S	PECIFIC LOCATION	IDENTIFIER		
SIRCO SYSTEMS		2 8	328 5	th AVE	NOR	TH	
03 CITY		04 STATE	05 ZIP CODE 0	6 COUNTY		07COUNTY	
BIRMINGRAM		AL	35204	JEF FER	son	073	O6
	ONGITUDE		<u> </u>				
33 3 1 06 86	49 24.						
10 DIRECTIONS TO SITE Starting from nearest public road,		<u> </u>					
2828 5th AVE	NORTH	Of	R AIR	PORT	HIG	HWAY	
III. RESPONSIBLE PARTIES							
OI OWNER (IT KNOWN). LEASED (REVNOLDS ALLIAN) LEASED (REVNOLDS ALLIAN)	WAL INS	02 STREE	「(Business, mailing, res	idential)			
O3 CITY	anti on	04 STATE	05 ZIP CODE	06 TELEPHONE	NUMBER	T	
				()		1	
07 OPERATOR (If known and different from owner)		08 STREE	(Business, mailing, res				
SIRCO SYSTEMS		28	28 5	th Ave	NOR	T74	
09 CITY		1 .	11 ZIP CODE	12 TELEPHONE		1	
Birming ham		AL	35204	(ZoS) 25	4-353	3	
13 TYPE OF OWNERSHIP :Check ane,				1.000			
A. PRIVATE B. FEDERAL:	'Agency name;		L C. STATE	.D.COUNTY	E. MI	JNICIPAL	
F. OTHER:	ecity;		G. UNKNO	NWC			
14 OWNER: OPERATOR NOTIFICATION ON FILE (Check all that apply					/	0 01	
A RCRA 3001 DATE RECEIVED:	B. UNCONTROL	LED WAST	SITE CERCLA 163	DATE RECEIVE	MONTH	7 101 C	NONE
IV. CHARACTERIZATION OF POTENTIAL HAZARD							
	Check all that apply!	A CONTRA	OTOB * (CTATE	T.D. OTHER	CONTRACTOR	
NO MONTH DAY YEAR	E. LOCAL HEALTH OFF	ICIAL I	CTOR X			CONTRACTOR	
	NTRACTOR NAME(S):				(Specify)		
02 SITE STATUS (Check one.	03 YEARS OF OPER	ATION					
A. ACTIVE [. B INACTIVE] C. UNKNOWN		950	5		UNKNOW	/N	
04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOW		BEGINNING YE	AR ENDING Y	EAR			
WASH-UP SOLVENT FR	054 5011	COR	T 74.1417	146 (N	1445	6AL.DEW	mslur
WASH-UT SOCUENT FIX	one muce	<i>-</i>	· kutiwi	100 10			(4.
05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT A	ND/OR POPUL ATION						
NO HAZARD, THE	SOLVENT A	JASTE	HAS		aken		
ALL WARTH AND RECY	cled to s	SIRCO	SUSTEN	ns. SIRC	0 15	IN PRO	cess
OF OBTAINING GENER	ATOR EPA	ID N	o · As	ALLWOR			
THEM THEY WILL	NO LONGE	18 TA	CE WAS	TE WITHO	ut 1	D. NUMB	ER.
V. PRIORITY ASSESSMENT							
01 PRIORITY FOR INSPECTION Check one It high or medium is checke A. HIGH	ed. complete Part 2 - Waste Info	rmation and Par	3 - Description of Hazar D. NONE	dous Conditions and Inc	iaents)		
'Inspection required promptly) Inspection required		e available basis	iNo furthe	er action needed, comple	ete current dispo	sitron form.	
VI. INFORMATION AVAILABLE FROM							
01 CONTACT	02 OF Agency Organi					03 TELEPHONE N	
STEVE MAURER	ADEN	1				(205)27/-	1126
04 PERSON RESPONSIBLE FOR ASSESSMENT WILL IN ARREN	05 AGENCY EPS	06 ORGA	NIZATION	07 TELEPHONE (601)922		OB DATE	84

-	$\mu \Delta$
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POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT

	IFICATION	
01 STATE	02 SITE NUMBER	•

ACI				EINFORMATION			
II. WASTE ST	TATES, QUANTITIES, AN	D CHARACTERI	STICS				
	TATES (Check ar that apply)	02 WASTE QUANTI	ITY AT SITE	03 WASTE CHARACTE	ERISTICS Chack at marac	(£(ç)	
		f waste quantifies index en fenti	A TOXIC E. SOLUB B. CORROSIVE F. INFECT C. RADIOACTIVE G. FLAMM D. PERSISTENT H. IGNITA		TIOUS JEXPLOS MABLE K REACTI ABLE L INCOMP	SIVE IVE PATIBLE	
D OTHER	(Specify)	NO OF DRUMS	-			M NOT AF	PLICABLE
III. WASTE T	YPE						
CATEGORY	SUBSTANCE NA	AME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS		
SLU	SLUDGE						
OLW	OILY WASTE						
SOL	SOLVENTS						
PSD	PESTICIDES						
occ	OTHER ORGANIC CH	EMICALS					
IOC	INORGANIC CHEMIC	ALS					
ACD	ACIDS						
BAS	BASES						
MES	HEAVY METALS						
IV. HAZARDO	OUS SUBSTANCES (See Ap	penark for most frequent	ly oiled CAS Numbers)				
01 CATEGORY	02 SUBSTANCE NA	AME	03 CAS NUMBER	04 STORAGE DISF	POSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
				ļ			
	<u> </u>						
V. FEEDSTO	CKS (See Appendix for CAS Numbe	975,		<u> </u>		<u> </u>	
CATEGORY	·		02 CAS NUMBER	CATEGORY	01 FEEDSTO	OCK NAME	02 CAS NUMBER
FDS				FDS			
FDS				FDS			
FDS				FDS			
FDS				FDS			
VI. SOURCES	S OF INFORMATION Cite s	specific references, e.g.	state files: sample analysis	reports i			
							

ADEM FILES

CONVERSATION WITH - CHUCK BENT - REYNOLDS METALS - 864-28-2918
ED CAIN - SIRCO SYSTEMS - 205-254-3533

\$EPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION

01 STATE 02 SITE NUMBER

II. HAZARDOUS CONDITIONS AND INCIDENTS			
01 A. GROUNDWATER CONTAMINATION 03 POPULATION POTENTIALLY AFFECTED:	02 OBSERVED (DATE) 04 NARRATIVE DESCRIPTION	POTENTIAL	ALLEGED
01 [] B. SURFACE WATER CONTAMINATION 03 POPULATION POTENTIALLY AFFECTED	02 OBSERVED (DATE) 04 NARRATIVE DESCRIPTION	POTENTIAL	: ALLEGED
01 ☐ C CONTAMINATION OF AIR 03 POPULATION POTENTIALLY AFFECTED:	02 . ! OBSERVED (DATE:) 04 NARRATIVE DESCRIPTION	POTENTIAL	ALLEGED
01 (.) D. FIRE/EXPLOSIVE CONDITIONS 03 POPULATION POTENTIALLY AFFECTED:	02 OBSERVED (DATE) 04 NARRATIVE DESCRIPTION	POTENTIAL	ALLEGED
01 [.] E. DIRECT CONTACT 03 POPULATION POTENTIALLY AFFECTED:	02 OBSERVED (DATE) 04 NARRATIVE DESCRIPTION	POTENTIAL	ALLEGED
01 :: F. CONTAMINATION OF SOIL 03 AREA POTENTIALLY AFFECTED:	02 J OBSERVED (DATE	POTENTIAL	. ALLEGED
01 [] G. DRINKING WATER CONTAMINATION 03 POPULATION POTENTIALLY AFFECTED:	02 OBSERVED (DATE) 04 NARRATIVE DESCRIPTION	POTENTIAL	. ALLEGED
01 LJ H. WORKER EXPOSURE/INJURY 03 WORKERS POTENTIALLY AFFECTED:	02 L. OBSERVED (DATE:) 04 NARRATIVE DESCRIPTION	POTENTIAL	ALLEGED
01 : 2 i. POPULATION EXPOSURE/INJURY 03 POPULATION POTENTIALLY AFFECTED:	02 OBSERVED (DATE:	POTENTIAL	ALLEGED

ŞEPA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT

I. IDENTIFICATION						
01	STATE	02 SITE	NUMBER			

PART 3 - DESCRIPTION OF HAZ	ZARDOUS CONDITIONS AND INCIDENT	s — —	
II. HAZARDOUS CONDITIONS AND INCIDENTS (Continued)			
01 E2 J. DAMAGE TO FLORA 04 NARRATIVE DESCRIPTION	02 C OBSERVED (DATE:)	☐ POTENTIAL	C; ALLEGED
01 C. K. DAMAGE TO FAUNA 04 NARRATIVE DESCRIPTION (Include name(s; of species)	02 🗆 OBSERVED (DATE:)	☐ POTENTIAL	☐ ALLEGED
01 🗆 L. CONTAMINATION OF FOOD CHAIN 04 NARRATIVE DESCRIPTION	02 GBSERVED (DATE:)	☐ POTENTIAL	L) ALLEGED
01 M. UNSTABLE CONTAINMENT OF WASTES (Spills runoff-standing liquids-leaking drums) 03 POPULATION POTENTIALLY AFFECTED:	02 C OBSERVED (DATE:) 04 NARRATIVE DESCRIPTION	□ POTENTIAL	© ALLEGED
01 L. N. DAMAGE TO OFFSITE PROPERTY 04 NARRATIVE DESCRIPTION	02 [OBSERVED (DATE:)	(i) POTENTIAL	(1) ALLEGED
01 () O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs 04 NARRATIVE DESCRIPTION	02 [] OBSERVED (DATE:)	☐ POTENTIAL	(ALLEGED
01 [P. ILLEGAL/UNAUTHORIZED DUMPING 04 NARRATIVE DESCRIPTION	02 [" OBSERVED (DATE:)	C POTENTIAL	∷ ALLEGED
05 DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR ALLEG	GED HAZARDS		······································
III. TOTAL POPULATION POTENTIALLY AFFECTED:			
IV. COMMENTS			
V. SOURCES OF INFORMATION (Cite specific references, e.g. state files, s	samble analysis, reports)		

POTENTIAL HAZARDOUS WASTE SIT' PRELIMINARY ASSESSMENT EPS FORM 3012-I EPS ANALYST/REVIEWER CHECKLIST

Instructions:

To be used in conjunction with EPA Form 2070-12 (7-81). Attach on inside front of site folder. Initial and date for all assessment entries under appropriate part/subpart as completed. initial/date in black for final assessment; in red if higher level (additional) assessment is in order. Follow same procedure for review process.

Review Codes:

1-Toxicology Review; 2-Chemical Review; 3-Ecology Review; 4-Chemical Engineer Review; 5-Geotechnical Review; 6-Project Manager Review; 7-Final Review

1. ANALYST/REVIEW STATUS Form 2070 Analyst/ Review Review Review Review Review Review Review Code 4 Part Number Date Code 1 Code 2 Code 3 Code 6 Code 7 Code 5 1.I.-VI. 2.I. 2.11. 2.111. 2.IV. 2.V. 2.VI. 3.I. 3.I1.A 3. II.B 3.11.C 3. II.D 3.II.E 3.II.F 3.II.G 3.II.H 3.II.I 3.II.J 3.II.K 3.II.L 3.II.M 3. II.N 3.11.0 3. II.P 3.111. 3.IV. .V.

^{&#}x27;No further assessment/review required, enter NA

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT EPS FORM 3012-II

TELEPHONE LOG SHEET

1.	Site Identification:
	Site number: ALDOS4563887
	Site name: SIRCO SYSTEMS INC.
2.	Interview Data: (Party called)
	Name: ED CAIN
	Position:
	Firm: SIRCO SYSTEMS INC
	Address: 2828 Sth. Ave North
	BIRMINGHAM AL. 35204
	Telephone No.: 205-254-3533
3.	EPS Analyst Data:
•	Name: WILL WARREN
	Purpose of call: TO DETERMINE OWNER AND HAZARDONS
	WASTE ACTIVITY
	Form 2070-12 (7-81) P.N.
	Date of call: 8/1/84
4.	Interview Narrative Summary: MR. CAIN CONFIRMED THE PURCHASE
	OF SIRCO FROM REYNOLDS IN 1979. SIRCO IS OWNED
	BY JEMISON INVESTMENT CO. LAND COMPANY USES IS
	LEASED FROM REYNOLDS ALUMINUM, LIBERTY NATIONAL INS.,
	NORFOLK SOUTHERN RAILWAY AND WALKER C. MADISON,
	BIRCO PRODUCES APPROXIMATELY 15 DRUMS PER
	YEAR OF WASH-UP SOLVENT WASTE FROM ROLL
	COAT DAINTING. ALLWORTH HAS TAKEN WASTE AND
	RECYCLED THE SOLVENT TO SIRCO. ALLWORTH HAS
	TOLD SURCO THEY CAN NO LONGER TAKE THE
	WASTE WITHOUT AN EPA GENERATOR 1.D. NUMBER.
	SIRCO IS IN THE PROCESS OF OBTAINING A
	CENERATOR NUMBER. TO THE BEST OF MR. CAIN'S KNOWLEDGE
	THERE HAS BEEN NO ON-SITE DUMPING ACTIVITY."
5.	Disposition/Comments:
	NO PURTHER ACTION.
6.	Commants: Now additional sites used by this someony?
O •	Comments: Any additional sites used by this company? Location:
	Dates of use.
	Description of waste:
	pescription or waste.
	Comments:
	CORRECTION

POTENTIAL HAZARDOUS WASTE SITE PRELIMINARY ASSESSMENT EPS FORM 3012-II

TELEPHONE LOG SHEET

1.	Site Identification: Site number: ALDOSAS 63887
	Site name: SIRCO SYSTEMS INC.
2.	Interview Data: (Party called) Name: CHUCK BENT Position: Firm: REVNOLOS METALS Address: 6601 W. BROAD ST. RICHMOND, VA. 2326/ Telephone No.: 804-281-2918
3.	EPS Analyst Data: Name: Name: Purpose of call: Form 2070-12 (7-81) P.N. Date of call: Thife4
4.	Interview Narrative Summary: MR. BENT SAID REYNOLDS SOLD SIRCO APPROXIMATELY 5 YRS. ACO.
	THE SUPERFUND NOTIFICATION WAS A PROTECTIVE MATIFICATION, TO THE BEST OF IMS KNOWLEDGE HE KNEW OF NO ON-SITE DUMPING ACTIVITY,
5.	Disposition/Comments:
	
6.	Comments: Any additional sites used by this company? Location: Dates of use: Description of waste:
	Comments:

Et. Onscey A. White, Ur. Chairman

Thomas F. Daursy
L. Ernes: Fs.ner - 2.E.
Interim Co-Directors

James \ Harr interim Deputy Director Cor on Members:

Tomar to Dear Contgomery

Dr. of Ext. Education Immingham

Control Farmer A.E., Mobile

Graves Sylacauga

Dr. Cameron 350 Jonald, Birmingham

Russell L. Riiey, Auburn

Mailing Address: State Capitol Scottgomery, AL 36130 Telephone: 205/277-3830 .

三方で東京 高さい場のから

。在八年的大學與非常的"主義"(1945年),「日本學院教育學院,在1966年期,這一個學院教育學院,但是一個學院的學院,也可以是一個學院,但是一個學院的學院,但是一個學院的學院,但是一個學院的學院,

December 10, 1982

MEMCKANDUM

TO:

Har la Taylor

FROM:

Joe Brewer 4

RE:

Sirco ystems, Inc.

On November 5, 1982, I men with Mr. he dear of three systems. Inc. and discussed the past hazardous waste activity. Wr. data sected that so the knowledge, no hazardous waste has ever been burded on the property that we ded require Superfund action. An inspection of the property did not reveal any evidence of a past hazardous waste site.

Sirco Systems, In a makes at the draw components. The waste generated at the facility in 1982, has been waste paper and at up order.

In 1981, the colvents generated at the radiciony were sold to All-Worth, Inc. of Birmingham, Alabama. Mr. Caun stated that no solvents have been generated at the plant in 1982.

JB:rc



IRA L. M. M.D. STATE HEALTH OFFICER

ing the second s Morning of the Same State of the

cunc -, ivox



TO:

Mere in marine the Oracle wife, indeed the

Hazardous & industrial Physic bediton

PROM: David Robe took, maker mendende of her

Hazaradas a landstraal waste Southin

KL:

Waste Macerial, bires systems, Inc., dirmingnam, Alabama

On May 26, 1961, I met with the following representatives of the above named company.

Mar Louis Romas - Part Bridge Mind, or

Wr. will recognism - I belet me Plant Mendger

Mr. Gary Penger - Plant Yoreman

This comes, I had approximately 80-50; fairty-fave gallon drums of a wax material to dispose on. The material is moved that and in recycled to a point where the mixture is approximately 75% water and the wax will no longer stick to metal. At this point, the waste is grained off into crums for disposal.

Since the local samutory Lancial's co not accept liquids, I called the county same cary expenses ing separt of the country redurn to the office. I was advised, and I passed the safermation of the was Faust by phone, to contact Mr. Bob Pogue, the pre-treatment engineer for the country, about disposing of this material by sewer.

I have not heard back from his. Faust at the time of this memo.

DLR:hj

2. PROJECT MANAGEMENT SUMMARY

Site Name: SIRCO SYSTEMS
Site Number: ALD 0 54563887
Owner: LEASED FROM REYNOLDS ALUMINUM, LIBERTY INS, NORFOLK SOUTHERN RAILWAY
Operator: SIRCO SYSTEMS
Site Status: Active / Inactive / Unknown
Priority: High Medium Low X None
,
3. FINAL DISPOSITION
I. EPS Final Review - Date: 8/1/84 Comments:
Site Inspection Required / Yes / No
II. ADEM Review - Date: 8 9 8 7 Comments:
Follow-up Action Required // Yes // No
III. Final Disposition: Review & revise Date: Edited & correct Date: Transmitted Date: File close-out Date: Initiate site
inspection Date:
4. ADDITIONAL COMMENTS (ONGOING & FINAL)

Notification of Hazardous Waste Site

15.
Photofinish 16. □ Lab/Hospital 17. 🗆 Unknown 18. ☑ Other (Specify) manufacture of <u>aluminum steel</u>

_Containers

United States Environmental Protection Agency Washington DC 20460

is

This initial notification information is required by Section 103(c) of the Compre-hensive Environmental Response, Compen-paper. Indicate the letter of the item sation, and Liability Act of 1980 and must

Please type or print in ink. If you need additional space, use separate sheets of which applies.

810609

	be mailed by June 9, 1981.		A	500	0 001 068	
Ā	Person Required to Notify:			<u> </u>	<u> </u>	
	Enter the name and address of the person	n Name Rey	nolds Metals Compar	ıy		
	or organization required to notify.	Street 660	1 W. Broad St.			
		City Ric	hmond	State VA	Zip Code 23261	
В	Site Location:	Name of City	SIRCO Systems			
	Enter the common name (if known) and actual location of the site.	Name of Site	DIRCO DYSCEMS			
	dotted to district of the one.	Street	2828 N. 5th Street	<u> </u>		
	ALD 0545 6388	7 CityBirmingham	CountyJefferson	State AL	Zip Code 35204	
\overline{c}	Person to Contact:	-				
	Enter the name, title (if applicable), and business telephone number of the person to contact regarding information submitted on this form.		e)Bent, Charles, Sta 2918	iff Env. En	gineer	
D	Dates of Waste Handling:					
	Enter the years that you estimate waste treatment, storage, or disposal began and ended at the site.	atment, storage, or disposal began and From (Year) 1950's To (Year) 1979				
 E	Waste Type: Choose the option you prefer to complete					
E	Option I: Select general waste types and you do not know the general waste types encouraged to describe the site in Item I—	or sources, you are		n and Recovery	persons familiar with the Act (RCRA) Section 3001	
		of Waste: n X in the appropriate	listed in the regulation appropriate four-digit the list of hazardous w	our-digit numbens under Section number in the l vastes and code	er to each hazardous waste on 3001 of RCRA. Enter the boxes provided. A copy of es can be obtained by ne State in which the site is	
	1. ☐ Organics 1. ☐ M	Mining	loodtod.			
		Construction				
		extiles				
		ertilizer				
		Paper/Printing				
		eather Tanning				
		ron/Steel Foundry		m 😓 -		
		Chemical, General		TT 52	9	
		Plating/Polishing		: در ۳۳	7.20	
	7 =	Military/Ammunition			* O	
		Electrical Conductors Transformers		(C		
		Italistormers Jtility Companies	1	Pos .	~ `	
		Sanitary/Refuse			¥8 N	
			1	- T		

Form Approved OMB No. 2000-0138 EPA Form 8900-1

	Notification of Hazardous Waste Site	Side Two	
=	Waste Quantity:	Facility Type	Total Facility Waste Amount
	Place an X in the appropriate boxes to indicate the facility types found at the site.	 □ Piles □ Land Treatment 	cubic feet Unknown
	In the "total facility waste amount" space give the estimated combined quantity (volume) of hazardous wastes at the site	3. □ Landfill 4. □ Tanks	Total Facility Area
	using cubic feet or gallons.	5. Impoundment	square feet Unknown
	In the "total facility area" space, give the estimated area size which the facilities occupy using square feet or acres.	6. ☐ Underground Injection 7. ☐ Drums, Above Ground 8. ☐ Drums, Below Ground	acres
	, Don's 14 and 1	9. M Other (Specify) <u>Unknow</u>	n
	Known, Suspected or Likely Releases	to the Environment:	
	Place an X in the appropriate boxes to indica or likely releases of wastes to the environment	ite any known, suspected, ent.	☐ Known ☐ Suspected ☐ Likely X☐ None
	Note: Items Hand I are optional. Completing hazardous waste sites. Although completing		nd local governments in locating and assessing uraged to do so.
H	Sketch Map of Site Location: (Optional Sketch a map showing streets, highways, routes or other prominent landmarks near the site. Place an X on the map to indicate the site location. Draw an arrow showing the direction north. You may substitute a publishing map showing the site location.	al)	
İ	Description of Site: (Optional)		
	Describe the history and present conditions of the site. Give directions to the site and describe any nearby wells, springs, lakes, or housing. Include such information as how waste was disposed and where the waste came from. Provide any other information or comments which may help describe the site conditions.		
J	Signature and Title: The person or authorized representative	Name Lawrence C. Tropea, 3	r
	(such as plant managers, superintendents, trustees or attorneys) of persons required to notify must sign the form and provide a mailing address (if different than address in item A). For other persons providing notification, the signature is optional. Check the boxes which best describe the relationship to the site of the person required to notify. If you are not required to notify check "Other".	Street 6601 W. Broad St. City Richmond State Signature Signature	UMner, Present ☑ Owner, Past ☐ Transporter ☐ Operator, Present ☐ Operator, Past ☐ Other

9	FPA

REGION SITE NUMBER (to be ac-

\$EPA ,		POTENTIAL HAZARDOUS WASTE SITE TIFICATION AND PRELIMINARY ASSESSMENT					
	ted for each potential hazardous waste s sed on available records and may be upd						
ALD054563887 SIRCO SYSTEMS		ind si	abmit a copy to: [J.S. Envir	tion II (Preliminary onmental Protection ington, DC 20460.		
- 2828 N. STH ST - Birmingham	AL 35204	TION.					
DICHINGHAM	ND 33204	ET _I (o	r other identifier)				
		·E	E. ZIP CODE	F. COUI	NTY NAME		
G. OWNER/OPERATOR (If know	vn)			<u> </u>			
1. NAME	A = 2			2. TELE	EPHONE NUMBER		
H. TYPE OF OWNERSHIP	arm C			1			
1. FEDERAL 2. S	TATE 3. COUNTY 4 MUNICIPA	L 25	PRIVATE6	UNKNO#^			
I. SITE DESCRIPTION							
Man Eucline	1 dotal and	1000	bonen to				
J. HOW IDENTYFIED (I.e., citiz	en's complaints, OSHA citations, etc.)	7			K. DATE IDENTIFIED (mo., day, & yr.)		
NOTI	′ (66 /0 /		
L. PRINCIPAL STATE CONTAC	<u>.</u>				100/8/		
1. NAME/	, ,			2. TELE	PHONE NUMBER		
Hart Cale	Kel Sup.			205	1939-1303		
A. APPARENT SERIOUSNESS O	II. PRELIMINARY ASSESSMENT	complete	this section last)				
	EDIUM 3. LOW TA NONE	5	пикиоми				
B. RECOMMENDATION			<u>,</u>				
. NO ACTION NEEDED (o hazard)	2. IMME a. TEN	DIATE SITE INSPECT ITAT VELY SCHED	CTION NE	EDED R:		
3. SITE INSPECTION NEE	DED Duled for:	b. WIL	L BE PERFORMED	BY:			
b. WILL BE PERFORMED) BY:	-	· · · · · · · · · · · · · · · · · · ·				
		4. SITE	INSPECTION NEED	ED (low pr	iority)		
C. PREPARER INFORMATION							
1. NAME	6.	2. TELE	PHONE NUMBER		3. DA FE (mo., day, & yr.)		
<u> </u>	III. SITE INFOR	1205	1831-13c	\$	1 3/24/83		
A. SIZE STATUS	III. SITE INFOR	MATION					
1. ACTIVE (Those industrial municipal sites which are being for waste treatment, storage, or on a continuing basis, even if inquently.)	disposal wastes.) (The	nose sites t	t (epecify): hat include such inc continuing use of the	idente like site for w	"midnight dumping" where aste disposal has occurred.		
B. IS GENERATOR ON SITE?							
1. NO	2. YES (epocify generator)	's lour-dig	it SIC Code):				
C. AREA OF SITE (in acres)	D. IF APPARENT SERIOUSNESS C 1. LATITUDE (degmineec.)	OF SITE IS	HIGH, SPECIFY CO				
E. ARE THERE BUILDINGS ON	THE SITE?						
	(specify):						

00	Continued From Front											
				IV.	CHARACTERIZATI	01	OF SITE ACTIVITY	1				
Inc	Indicate the major site activity(ies) and details relating to each activity by marking 'X' in the appropriate boxes.											
. x .	A. TRANSPOR		Tx:	B. STORER		×	C. TREATER		×			ISPOSER
	1. RAIL		1 P	ILE			I. FILTRATION		1	. LANDFIL		
	2. SHIP		2.50	URFAC	E IMPOUNDMENT		Z. 'NCINERATION		2	. LANDFA	RM	
	3. BARGE		3. D	RUMS			3. VOLUME REDUCTI	ON	3	. OPEN D	JMF	
	4. TRUCK		4. T	ANK, A	BOVE GROUND	Ì	4. RECYCLING/RECO	VERY	4	SURFAC	E 11	MPOUNDMENT
	5. PIPELINE		5. T	ANK. 8	ELOW GROUND		5. CHEM./PHYS. TRE	ATMEN	5	MIDNIGH	Τ (DUMPING
	6. OTHER (specify):		6.0	THER	(specify):		6. BIOLOGICAL TREA	TMENT	6	INCINER	AT	ION
					<u> </u>	7	7. WASTE OIL REPRO	CESSIN	5 7	UNDERG	RO	UND INJECTION
					ţ		8. SOLVENT RECOVE	RY	a	. OTHER (SDe	cily):
	9. OTHER (specify):											
E. SPECIFY DETAILS OF SITE ACTIVITIES AS NEEDED												
					V. WASTE RELAT	ΕD	INFORMATION		·			
Α.	WASTE TYPE				V. WASTE RELAT		THEORMATION					
_]1 UNKNOWN [] 2. 1	LIQUID	3.	SOLID4. s	LU	DGE5. G	A S				
	WASTE CHARACTER											
_]1 UNKNOWN [2. (CORROSIVE	□3.	GNITABLE4 R	AC	DIOACTIVE5 H	IGHLY	OLAT	'ILE		
_	6 TOXIC]7	REACTIVE	В	NERT9 F	L /	MMABLE					
	1 UNKNOWN 2. CORROSIVE 3. IGNITABLE 4 RADIOACTIVE 5 HIGHLY VOLATILE 6 TOXIC 7 REACTIVE 8 INERT 9 FLAMMABLE 10. OTHER (specify):											
	WASTE CATEGORIE											
1	. Are records of wast	es a	vailable? Specif	fy item	s such as manifests, in	ıve	ntories, etc. below.					
2	. Estimate the amou	unt (specify unit of	f meas	ure)of waste by cate	90	rv: mark 'X' to indic	ate whi	ch wa:	stes are p	res	ent.
	a. SLUDGE	1	. b. OIL	T	c. SOLVENTS	Ť	d. CHEMICALS	1	. SOL		Ì	(, OTHER
AM	OUNT		DUNT	- t	MOUNT	╁	MOUNT	AMOUN			AN	OUNT
				ł		ı						
ÜИ	IT OF MEASURE	UNI	T OF MEASURE	E U	NIT OF MEASURE	u	NIT OF MEASURE	UNIT	FME	SURE	UΝ	IT OF MEASURE
		٠.						}				
'X'	(1) PAINT, PIGMENTS	×·	(1) OIL Y WASTES		(1) HALOGENATED SOLVENTS	Ė	(1) A CIDS	'X'(1) F	LYASH	+	· x ·	LABORATORY PHARMACEUT.
	2) METALS SLUDGES		(2)OTHER(spec	cify):	(2) NON-HALOGNED SOLVENTS	1	(2) PICKLING LIQUORS	(2) A	5BE5	ros		(2)HOSPITAL
	(3) POTW				(3) OTHER(specify)		131 C A USTIC 5		ILLIN	G/ AILINGS		(3) RADIOACTIVE
	(4) AL JMINUM SLUDGE						(4) PESTICIDES	4, 5	ERRO MLTG	US WASTES		(4) MUNICIPAL
	(5) OTHER(specify):						(5) DYES/INKS	1515	ION FE	ERPOUS . WASTES		(5) OTHER(specify):
							(6) CYANIDE	(6) 0	THER	(specify):		
							(7) PHENOLS					
							(8) HALOGENS					
		<u> </u>					(9) PCB					
							(10) METALS					
							(11) OTHER (specify)					
		1						l			1	

ENVIRONMENTAL PROTECTION SYSTEMS, INC. Alabama RCRA 3012 Site Ranking Scheme EPS Form 3012-V

Site Name SIRCO SYSTEMS
Site Number ALDOS4 563887

Preliminary Assessment Ranking Scheme to Determine Which Sites Merit Further Action.

(Select one answer for each of the following seven questions)

1.	Are Hazardous Sub A. Confirmed on B. Suspected at C. It is unknown D. No hazardous E. RCRA facility	site! site! ! substances	10 points 5 points 2 points 0 points 0 points	<u>X</u>	
2.	A. Direct to sur B. Indirect to s	ion Dispersal Pathway? face and/or groundwater. urface and/or groundwater. surface and/or groundwater. sure.	5 points 4 points 3 points 2 points 0 points	<u>X</u>	
3.	Characteristics of A. High density. B. Medium density. C. Low density. D. No population	y•	5 points 4 points 3 points 2 points		4/4
4.	A. Critical habi species, et B. Sensitive hab		5 points 3 points 2 points		NA
5.	A. Public utilit from site. B. Direct public C. Public access surface wat D. Only potentia population	er. 1 for human	5 points 4 points 3 points 2 points 1 point		N/A
6.	A. Site actively currently woother permi	ent Practices at Site? supervised and managed with monitoring reports and t and report requirements. Itely managed records ate.	1 point 3 points		YA

	С.	Site not currently managed or regulated.	4 points	
	D.	Abandon site.	5 points	
7.		ential Responsible Parties for Site perations?		N
		Controlling party identified and accepts responsibility for site.	l point	, ,
	В.	Suspected controlling party identified but does not accept responsibility		
	•	for site.	4 points	
	C.	No responsible party available.	5 points	
Ran	king	Score =		
	10 #1	$\begin{bmatrix} \times & 0 & + & \sqrt{14} & + & (\sqrt{14} & \times & \sqrt{14}) & + \\ & & & & & & & & & & & & & & & & &$	<u>NA</u> + <u>NA</u>	

TABLE 1. Ranking Assessment

NUMERICAL RANGE	PRIORITY ASSESSMENT
0-50	NONE
50-150	LOW
150-300	MEDIUM
300-450	HIGH

Ranking Score: O
Priority Assessment: NowE



CUNSHURUCKEN . PENNSYLVANIA 19428

apral 50, 1981

Sirco Systems P.O. Box 657 Birmingham, AL. 35201

ATTN: Louise Faust

Purchasing Manager

Dear Ms. Faust:

We are enclosing Material Safety Data Sheets for products of interest to you. I trust chose will meet with your requirements. Should you have need of additional details, please do not hesitate to contact me.

Very truly yours,

Hathryn 7 Strang Kathryn F. Strang

Coordinator-Regulatory Affairs

KFS:eg

ENC: MSDS for FERROCOTE 120.

CC: R. Duell

Ag /81- 8th Hamilton words, Ly can't the line of at all 1 were send have Robinson of tale by he view my proposed

		Samuel Dat a
THRUSECO	VALUE	
EFFECTO OF CALRE	A Property of the Control of the Con	
V LANGUAGA	<pre>************************************</pre>	in 1921. The main of the state of the contact with
ومعلمين فبلغوث لالانتكافيات		d Waler and Check II necessary.
INMA TION. N	Grand Indah usm Linear Grand	on tal tophy return. Apply notificial respiracio
	ož diji	ON MORRIAGE SITY DATA
STABILITY	UNSTAULL	CONDITIONS TO AVOID
	STABLE A	
INCOMPATABILITY	Mulerius to modely	octor _e oktornosti starong acrás
HAZARDOUS DECO.	MPOSITION PROBUSTS	tione
HAZARDOL:	NAY OLCUR	CONDITIONS YOU AVOID
	W.L. NOT GEEUR	
	% JT.0N ∨	A SANDERON PARENTE PAR
STEPS TO BE TAKE	N IN CASE MATERIAL IS A.	LUASED OR EPILLED
in i	e with area with conc	12 10 10 en la servalaze with mild acid
WASTE DISPOSAL N		Apolis and weekly
		· · · · · · · · · · · · · · · · · · ·
		ca of water, normalize with hulo acid and
dispo	ese of in demonishe	e with local, state and federal EPA regulations.
	SESTION VII. •	UPECIAL PROTECTION INFORMATION
	TECTION Sprain 1943	
VENTILATION	LOCAL EXPACES	SPECIAL
•	MECHANICAL (General)	OTHER
PROTECTIVE GLOV	LES RECONMENDED	EYA PROTECTION WEAR SAFETY GLASSES
OTHER PROTECTIV	E EQUITMENT EYE WAS	SA MACILITY AND SAVETY SHOWER.
	COT AST D	AL NO CORRESPONDE CONTRACTOR OF THE CONTRACTOR O
PRECAUTIONS TO I	SECTION BE TAKEN IN HANDLING A	N IN - SPECIAL PARCAUTIONS
KEEP	FROM PASEZING!	
OTHER PRECAUTIO		
NONE		
PAGE (2)		620 934-34 430KFSCR Form OSHA-2 6

Rev. May 72

ALL INFORMATION

		A
		A
7		#

POTENTIAL HAZARDOUS WASTE SITE IDENTIFICATION AND PRELIMINARY ASSESSMENT

REGION SITE NUMBER (to be se-

Assessment), File this form in the Regional LD05456388/ JEFFERSON	1		submit a copy t N-335); 401 M	St., SW; Washi	ington, DC 20460.
IRCU SYSIEMS 828 STA ST	1068	ICATION	N or other Identifie	(or)	
828 A. STA ST IRMINGHAM	AL 35204				
ENT, CHARLES, STAFF ENV*		TATE	E. ZIP CODI	E F. COUN	NTY NAME.
Regnoll Metale				2. TELE	EPHONE NUMBER
H. TYPE OF OWNERSHIP		.,		L	
1. FEDERAL []2. STATE []3 COL	UNTY 4 MUNICIP			E NENOWN	
	-	Un	town		
	: 810 60 9			TO CAPPENDA OF STREET	
NE: 205-832-6728		TO THE SECTION OF THE			K. DATE IDENTIFIED (mo., day, & vr.)
				:: TELE	PHONE NUMBER
II. PRELM	MINARY ASSESSMENT	r (complete	this section !	· · · · · · · · · · · · · · · · · · ·	
A. APPARENT SERIOUSNESS OF PROBLEM []1. HIGH []2. MEDIUM []3 LOW	W []4 NONE	5	UNKHOWN		
B. RECOMMENDATION 1. NO ACTION NEEDED (no hezerd)		2. IMME	IDIATE SITE IN	NSPECTION NEE CHEQULED FOR	EDED
3. SITE INSPECTION NEEDED 8. TENTATIVELY SCHEDULED FOR:		b. WIL	LL BE PEPFOR	MED BY:	
b. WILL SE PERFORMED BY:		1/-	TTTION		
		1 4. SHE	Shi	NEEDEO (low pa	ority)
C. PREPARER INFORMATION 1. NAME	WAJZVIHH	2. TEL	EPHONE NUMB	3EP	3. DA FE (MO., day, & y
	III. SITE INFO	ORMATION		and the same of th	<u> </u>
A. SITE STATUS					
1. ACTIVE (These industrial or municipal sites which are being used for waste treatment, stolage, or disposal on a continuing basis, even if intrequently.)	NACTIVE (Those files no longer receive)	3. OTHER Those sites: o regular or	R (specify): that include sui continuing use	th incidents like of the site for wi	s "midnight dumping" wh aste disposal has occurre
į .					
3. IS GENERATOR ON SITE?					
	2. YES (apactly generate	or's four-dig	pit SIC Code):	The second second of the second second	

Continued From Front								
		I√. CHARACTERIZATIO	ON OF SITE ACTIVE	Υ				
Indicate the major sit	e activity(ies) and	details relating to each ac	tivity by marking 'X' i	n the approp	riate boxes	•		
A. TRANSPOR	TER X	B. STORER	C. TREATER	, '×'	D	. DISPOSER		
1. RAIL	(P(L	E	1. FILTRATION		1. LANDFIL	. L		
2. SHIP	2. 501	AFACE IMPOUNDMENT	2. INCINERATION		2. LANDFA	RM		
3. BARGE	3. DR	UMS	3. VOLUME REDUCTI	ОИ	3. OPEN DU	IMP		
4. TRUCK	4. TA	NK, A BOVE GROUND	4. RECYCLING/RECO	VERY	4. SURFACE	E IMPOUNDMENT		
5. PIPELINE	5. TA	NK. BELOW GROUND	5. CHEM./PHYS. TRE	ATMENT	S. MIDNIGH	T DUMPING		
6. OTHER (specify):	6. 07	HER (specify):	6. BIOLOGICAL TREA		6. INCINER			
)	7. WASTE OIL REPRO		 	ROUND INJECTION		
}	Ì	<u> </u>	9. OTHER (specify):	IRY	B. OTHER (apecify):		
ł	ŀ	<u> </u>						
ŀ				1				
E. SPECIFY DETAILS OF SITE ACTIVITIES AS NEEDED								
		V. WASTE RELATE	ED INFORMATION					
A. WASTE TYPE								
]3. SOLID []4 SL	LUDGE5. G	AS				
B. WASTE CHARACTE		3. IGNITABLE []4 R	ADIOACTIVE THE	16H1 V 1/01 A	TUE			
		3. INERT [9 F		IGHET VOLK	1122			
L. John M. C.	J. 11271011140							
10. OTHER (specif	v):							
C. WASTE CATEGORIE	S					**************************************		
 Are records of wast 	es available? Specify	y items such as manifests, in	ventories, etc. below.					
2. Estimate the amo	unt(specify unit of	measure) of waste by cate	gory; mark 'X' to indic	ate which w	astes are pr	resent.		
a, SLUDGE	b. OIL	c. SOLVENTS	d. CHEMICALS	e. SOL	.IDS	f. OTHER		
AMOUNT	AMOUNT	AMOUNT	AMOUNT	AMOUNT		AMOUNT		
						·		
UNIT OF MEASURE	UNIT OF MEASURE	UNIT OF MEASURE	UNIT OF MEASURE	UNIT OF ME	LASURE	UNIT OF MEASURE		
				<u> </u>				
X' (1) PAINT, PIGMENTS	X' (1) OIL Y WASTES	'X' (1) HALOGENATED	'X'	(1) FLYAS	5 H	1X LABORATORY		
	<u> </u>			 				
(2) METALS SLUDGES	(2)OTHER(speci	(2) NON-HALOGNED. SOLVENTS	(2) PICKLING LIQUORS	(2) A 5 B E S	5TOS	(2) HOSPITAL		
 				 				
(3) POTW		(3) OTHER (specify)	(3) CAUSTICS	(31M)LLI MINE	NG/ TAILINGS	(3) RADIOACTIVE		
<u> </u>								
(4) ALUMINUM SLUDGE			(4) PESTICIDES	(4) FE.RR	OUS G. WASTES	(4) MUNICIPAL		
(5) OTHER(specify):				NON	ERROUS	(5) OTHER(specify):		
TI(S) OTHER(Specify).			(5) DYES/INKS	51 SML T	G. WASTES			
			(6) CYANIDE	(6) OTHE	R(specify):			
	i		TOTETANDE					
			(7) PHENOLS		1			
				-	ſ			
			(8) HALOGENS					
}				{	j			
ĺ			(9) PCB	1	j			
J				1	j			
			(10) METALS		İ			
			(11)OTHER(epocity)	1	l			
	I	I	l	I				

3. LIST SUBSTANCES OF GREATES			ED INFORMATION OF THE SITE (order of hezerd).
					·
4. ADDITIONAL COMMENTS OR NAM	RRATIVE DE	SCRIPTION O	F SITUATION KNO	WN OR REPORTED	TO EXIST AT THE SITE.
			فعال بيون عاردا المناسبات		
	9.		ARD DESCRIPTI	ON	
A. TYPE OF HAZARD	POTEN- TIAL HAZARD (mark 'X')	ALLEGED INCIDENT (mark 'X')	D. DATE OF INCIDENT (mo., day, yr.)		E. REMARKS
I. NO HAZARD					
2. HUMAN HEALTH					
S. NON-WORKER Injury/Exposure					
4. WORKER INJURY					
S. CONTAMINATION S. OF WATER SUPPLY					
CONTAMINATION OF FOOD CHAIN					
7. CONTAMINATION OF GROUND WATER					
CONTAMINATION OF SURFACE WATER					
DAMAGE TO FLORA/FAUNA					
10. FISH KILL					
11. CONTAMINATION OF AIR					
12. NOTICEABLE ODORS					
19. CONTAMINATION OF SOIL					•
14. PROPERTY DAMAGE					
S. FIRE OR EXPLOSION					
6. SPILLS/LEAKING CONTAINERS/ RUNOFF/STANDING LIQUIDS					
7 SEWER, STORM Drain Problems					
IS, EROSION PROBLEMS					
19. INADEQUATE SECURITY					
O, INCOMPATIBLE WASTES					
21. MIDNIGHT DUMPING					
2. OTHER (specify):					

Continued From Front								
VII. PERMIT INFORMATION								
A. INDICATE ALL APPLI	CABLE PER							
1 NPDES PERMIT	2. SPC	C PLAN	3. STATE PERMIT	(specify):				
4. AIR PERMITS	5. LO	CAL PERMIT	6. RCRA TRANSPO	RTER				
7 RCRA STORER	8. RC	RA TREATER []	9 RORA DISPOSER	7				
I) 10. OTHER (apecily): B. IN COMPLIANCE?								
1. YES	2. NO		3 UNKNOWN					
		V court						
4. WITH RESPECT T	ro (list regul	ation name & numbe	r):					
		VIII. I	AST REGULATO	RY ACTIONS				
A. NONE	B. YE	S (summerize below)					
		(V press						
		IX. INSPE	TION ACTIVITY	(past or on-going)				
A NONE	8. YES	(complete itema 1,	2,3, & 4 below)					
1. TYPE OF ACTIV	/!TY	2 DATE OF PAST ACTION (mo., day, & yr.)	3 PERFORMED BY: (EPA/State)	4. DESCRIPTION				
			[
<u></u>		V BEN	5014 1671474					
		A, KEM	EDIAL ACTIVITY	(past or on-going)				
A. NONE	8. YE	S (complete items 1,	2, 3, & 4 helow)					
1, TYPE OF ACTIV	VITY	2. DATE OF PAST ACTION (mo., day, & yr.)	3. PERFORMED BY: (EPA/State)	4. DESCRIPTION				
	·····							
				·				
			L					
NOTE: Based on the	informatio	on in Sections II	I through X, fill	out the Preliminary Assessment (Section II)				
information on the first page of this form.								

V. WASTE RELATED INFORMATION (continued)							
3. LIST SUBSTANCES OF GREATEST CONCERN WHICH MAY BE ON THE SITE (place in descending order of hezerd).							
		<u></u>					
4. ADDITIONAL COMMENTS OR NAI	RRATIVE DES	SCRIPTION O	F SITUATION KNO	WN OR REPORTED TO EXIST AT THE SITE.			
Facility generated works solve to which were shipped of sile							
A. TYPE OF HAZARD	B. POTEN- TIAL HAZARD (mark 'X')	C. ALLEGED INCIDENT (mark 'X')	D. DATE OF INCIDENT (mo.,day,yr.)	E. REMARKS			
I. NO HAZARD		isja.					
2. HUMAN HEALTH	Ĺ						
3. NON-WORKER INJURY/EXPOSURE							
4. WORKER INJURY	<u></u>						
5. CONTAMINATION 5. OF WATER SUPPLY							
CONTAMINATION OF FOOD CHAIN							
CONTAMINATION OF GROUND WATER							
CONTAMINATION OF SURFACE WATER							
DAMAGE TO FLORA/FAUNA							
IO. FISH KILL							
CONTAMINATION							
12. NOTICEABLE ODORS							
3. CONTAMINATION OF SOIL							
4. PROPERTY DAMAGE							
5. FIRE OR EXPLOSION		·					
6. SPILLS/LEAKING CONTAINERS/ RUNOFF/STANDING LIQUIDS							
7. SEWER, STORM 7. DRAIN PROBLEMS							
8. EROSION PROBLEMS							
9. INADEQUATE SECURITY							
O. INCOMPATIBLE WASTES							
1. MIDNIGHT DUMPING							
2. OTHER (specify):							
İ							

Cantinued From Front							
VII. PERMIT INFORMATION							
A. INDICATE ALL APPLICABLE PERMITS HELD BY THE SITE.							
1, NPDES PERMIT 2 SPCC PLAN 3. STATE PERMIT(specify):							
4. AIR PERMITS 5. LOCAL PERMIT 6. RCRA TRANSPORTER							
7 RCRA STORER 8 RCRA TREATER 9 RCRA DISPOSER							
10. OTHER (specify):							
B. IN COMPLIANCE?							
1. YES 2. NO	2. NO 3. UNKNOWN						
4. WITH RESPECT TO (list regulation name & number):							
VIII, PAST REGULATORY ACTIONS							
A. NONE B. YES (summarize below)							
	IX. INSPECTION ACTIVITY (past or on-going)						
A NONE B. YES (complete items 1,2,3, & 4 below)							
2 DATE OF 1 TYPE OF ACTIVITY PAST ACTION (mo., day, day, day)		3 PERFORMED BY: (EPA/State)	4. DESCRIPTION				
RCPA insterior	1/1/82	State	eneralor to las				
,			6				
	<u> </u>	<u> </u>					
	X. REM	EDIAL ACTIVITY	(past or on-going)				
A. NONE B. YE	ES (complete items 1,						
1. TYPE OF ACTIVITY	2. DATE OF		4. DESCRIPTION				
NOTE: Based on the information in Sections III through X, fill out the Preliminary Assessment (Section II) information on the first page of this form.							